THE

IMPERIAL HEALTH MANUAL

BEING THE AUTHORISED ENGLISH EDITION OF
THE OFFICIAL HEALTH MANUAL

ISSUED BY

The Imperial Health Department of Germany

EDITED BY

ANTONY ROCHE, M.R.C.P.I., ETC.

Professor of Medical Jurisprudence and Hygiene in the Catholic University of Ireland, Examiner in the Royal University, Fellow of the Sanitary Institute of Great Britain

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EDITOR'S PREFACE.

THIS volume needs little introduction at my hands. It is the official popular Manual of the Imperial Health Department of a country where all hygienic and social questions are studied with the greatest zeal. I thought that an English Edition might do something towards teaching the public the rudiments of Preventive Medicine. I have to express my obligations to the Director of the Imperial Health Department for graciously facilitating in every way the publication of this edition.

ANTONY ROCHE.

91 STEPHEN'S GREEN SOUTH, DUBLIN,

May, 1896.

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INTRODUCTION.

Importance of Attention to Health.

MAN'S health is a precious possession. The loss of it is productive of injury, not merely to the individual, but also to the community.

The individual whose health is destroyed suffers discomfort or pain ; he loses his power of work, his ability to earn a livelihood, and his enjoyment of the pleasures of life ; to restore his health he is obliged to incur unusual expense, and the results for himself and his family are anxiety and poverty.

Through the diminution of its productive labour the community suffers a loss in its industries and incurs expenditure in the support of the sick poor ; in the case of contagious diseases the unhealthy man is especially a danger to his neighbours.

The magnitude of the losses arising from the impairment of health can be estimated from the statistical return of the working men's sick clubs in Germany. In 1891, out of a total membership of 6½ millions, there were more than two million cases of sickness, and each sickness lasted on the average 17 days. The clubs paid in medical expenses 89½ millions of marks (£4,475,000). As it is safe to assume that among the remaining 44 millions of German citizens, 24 millions of whom are old enough to work, the

cases of sickness were equally numerous and equally protracted as among the members of the sick clubs, the expenses occasioned by sickness in Germany during the year 1891 is not rated too high at 500 millions of marks (£25,000,000). In this sum the loss due to the stoppage of wages is not included.

The preservation and promotion of man's health is the aim of the science of hygiene. Among the tasks it proposes to itself are the prevention, restriction, and removal of sickness and disease, and the preservation and prolongation of the power of labour and of man's life in general.

To attention to the demands of hygienic science may be ascribed the fact that the annual number of cases of sickness in the army fell from 1,496 per 1,000 men in 1868 to 759 per 1,000 men in 1888, and that there were 2½ million less days of active service lost by sickness in 1888 than in 1868.

In civil communities the decline in the death rate usually accompanying regular sanitary supervision may be taken as a standard for estimating the gain to the community arising from such supervision, as is evident from the following example:—According to Von Pettenkofer, there were in Munich, prior to 1877, 34 cases of sickness, each averaging 20 days, for each death recorded. The mortality in that city has decreased in the period from 1877 to 1892 from 33 per 1,000 inhabitants in the former year to 26·1 per 1,000 in the latter year—in round numbers, a decrease of 7 per 1,000 inhabitants. Hence, in a population of 373,000, Munich had 2,611 less cases of death in

1892 than under the conditions of mortality prevailing in 1877, and its inhabitants have also been spared in round numbers 1,750,000 days of sickness in 1892. Assuming that each day of sickness causes an expense of 1½ marks for nursing, medicine, etc., Munich has been saved an expenditure of more than 2½ millions of marks through the decrease in sickness—an average saving per head of nearly 8 marks, or 39 marks for each family of five persons.

In addition to the prevention of sickness, hygiene also discusses provisions for the suitable nursing and treatment of the sick, whereby their restoration to health may be most speedily and certainly attained. In this connection, among other expedients, the sick clubs are very important. They alleviate the lot of the sick and their families, help in lessening the number of days of sickness, and thus limit, as far as possible, the interruption to work and earnings occasioned by sickness.

For a full appreciation of the requirements of hygiene some knowledge of the nature and organism of the human body is indispensable.

THE

HEALTH MANUAL.

A. Structure of the Human Body, Function and Uses of its Organs.

Constituents of the Human Body.

§ **1. Description of the bodily constituents.** We must distinguish between the hard, the soft and the fluid constituents of the body.

The hard are the bones, the cartilages, and the teeth. The bones are united together by compact bands: they are collectively called the human skeleton.

The soft constituents of the body include the skin, the fatty tissue, the muscles, the viscera, the blood-vessels and the nerves. The blood-vessels and the nerves are spread through all parts of the body; the fatty tissue is found chiefly immediately under the skin, but it also traverses the muscles and viscera.

Among the fluid constituents of the body the blood is of most importance.

§ **2. Bones, Cartilage.** The bones, of which there are over 200 known in the human body, are partly reed-formed structures, in the cavity of which is contained a soft mass, rich in blood, called the marrow. Beside these reed-bones there are flat bones like the outer cranium, and spongy bones like the vertebræ. Each bone is covered by a fine membrane, the periosteum.

Many bones change at their ends into cartilage, an elastic mass similar to, but not so hard as bone. Independent cartilages unconnected with bone, are to be found in the larynx and the ear.

§ **3. Ligaments, Joints.** Bones are, as a rule, connected together by strong ligaments ; such a connection, if it permits movement of the bones, *inter se*, is called a joint. Each joint presents a hermetically-closed cap formed of the ligaments, in which rest the ends of the bones covered by a flat, cartilaginous mass. It contains a minute portion of a slimy, thread-like fluid, the joint-grease which facilitates the gliding of the ends of the bones over one another. While many joints (*e.g.*, the middle finger-joint) allow of movement in one plane only, others (*e.g*. the shoulder-joint) are capable of movements in several directions.

§ **4. Muscles, Sinews.** The muscles effect movements in the body and its various parts. They constitute the great mass of the flesh, are composed of bundles of fibres, and possess the property of shortening themselves by contraction, and of reverting to the longer form by relaxation from the contracted condition.

As a rule, the muscles lie between the skin and the bones, and are joined to the latter by means of ribbon-like prolongations, the sinews. When a muscle—like a stretched gum-string—contracts, it becomes shorter, and causes those parts of the body to which its ends are fastened to draw nearer to one another. For example, if in an outstretched arm, the fore-muscle of the upper arm contracts, the lower arm is brought nearer to the upper arm—that is, a bending of the arm at the elbow-joint follows. If the same muscle relaxes, then it becomes extended again, and the arm returns from the bent to the outstretched position as soon as the posterior muscle in the upper arm contracts.

§ **5. Glands.** Some organs belonging to the soft parts of the body, secrete fluids from their own tissue or from the blood that flows through them. These fluids are either turned to account in the economy of the body, as for instance, the gastric juices in the process of digestion; or they are expelled from the body and remove matter no longer profitable, as in the urine secreted in the kidneys. These organs are called glands, they usually possess one or several excretary ducts through which the secreted fluid is discharged. Besides the large glands, of which the liver is an example, there are little glands, scarcely visible without the aid of a magnifying-glass, like the perspiratory glands. The secretion of the glands may be a thin fluid, like the urine, or a slimy fluid, like the saliva, or viscous like the wax in the ear. Some other organs, which secrete nothing externally, are also called glands, as for example, the lymphatic glands.

§ **6. Skin, Mucous Membrane.** The skin, forms the external covering of the body; it consists of two layers, the tender epidermis or upper skin, and the hard skin underneath it. The upper skin is furnished with fine hairs, which in some places, as in the head, attain to a considerable length and thickness. The back of the extremities (the fingers and toes), are especially protected by a horny, non-sensitive substance, the nails. In the hard skin or derma are placed the skin-glands, small sack-like structures, the apertures of which on the surface are known as the pores of the skin. Some glands of the skin secrete a fatty mass, the skin tallow which is the cause of the flexibility and lustre of the skin; the sweat, which is both watery and salty, is secreted by other skin-glands.

The skin changes at the natural openings of the body into a similar covering, the mucous membrane. This

transition can be plainly observed at the lips and also at the eyelids, where the boundary line between skin and mucous membrane is marked by the eyelashes.

The mucous membrane extends over the cavities closely connected with the natural apertures in the body (nostrils, larynx, mouth, throat, stomach, bowels, &c.); it is of a more tender nature than the external skin, and has a red appearance as it allows the fine blood-vessels filled with red blood to be seen through it. The surface of the mucous membrane is of a moist, slippery nature owing to a mucus secreted by microscopically small glands.

Individual parts of the Body and their Structure.

§ **7. General Division of the Body.** The human body is divided into the head, the trunk and the limbs (Fig. 1.).

In the head it is usual to distinguish between the cranium and the face. The cranium, in shape approaching that of a hemisphere, encloses the cranial cavity wherein the brain is situated. In the cranium it is usual to distinguish the forehead in front, the crown on the top, the temples at both sides, and the occiput or poll at the back. The crown, the poll, and portion of the temples are covered with hair. In the face are noticed the eyes, the nose, the mouth, the cheeks and the chin. On the boundary line between cranium and face are situated the ears.

The trunk is divided into the neck, the hindmost part of which is called the nape; the breast, the belly, the back, the loins, and the pelvis, the sides of which are the hips. The hollow separating the trunk in front from the upper thigh is called the curve of the groin. The trunk

contains two great cavities filled with viscera, the thoracic and the abdominal cavity.

Among the limbs the upper limbs or arms, are distinct from the lower limbs or legs.

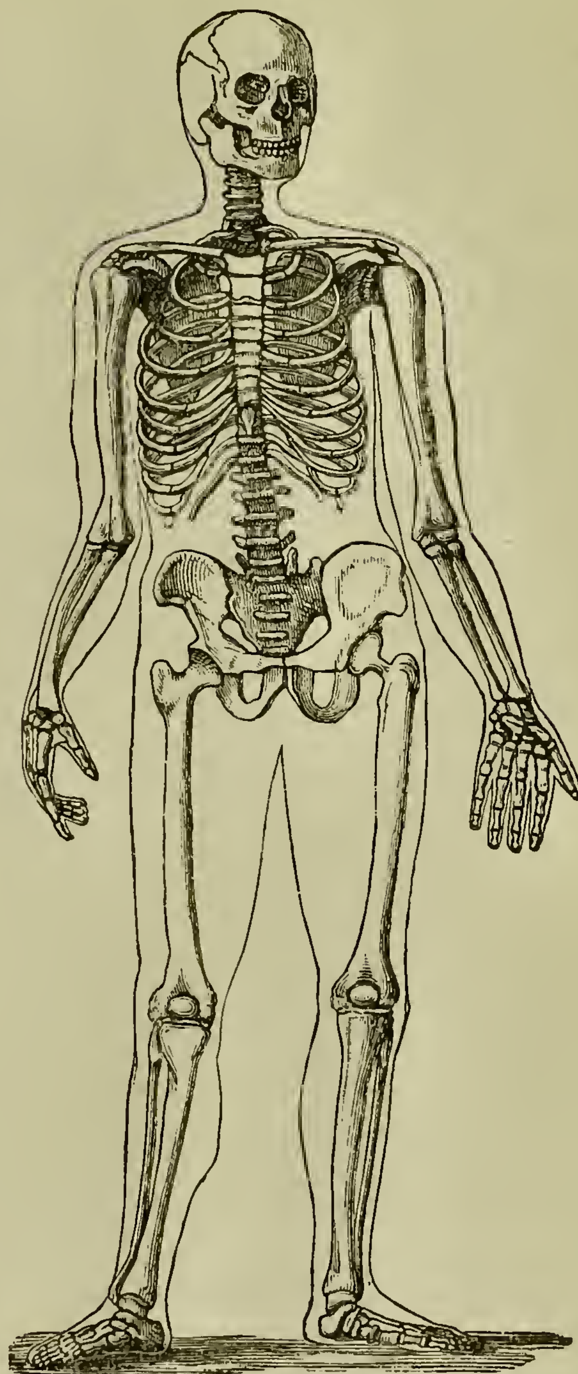

Fig. 1.
Skeleton.

§ 8. Head, Face, Facial Cavities. The head is composed of the cranial and facial bones, covered with soft tissues; these bones are nearly all joined together immovably. The lower jaw, one of the facial bones, alone possesses a power of motion; the ends of its joints are placed just in front of the ear, and their movements, as in chewing, may be perceived by placing the finger on that spot. Other facial bones are the two bones of the nose which join to form the osseous bridge of the nose, the malar processes or cheek bones, and the two bones of the upper jaw.

The bones of the face form, partly by themselves, partly in conjunction with the cranial bones as well as with cartilages and tissues, the two cavities for the eyes, the nasal cavity, and the cavity of the mouth.

The bony cavities of the eyes are widely open in front,

run back deeply into the head and become narrower as they recede. From their hindmost part a small round opening, through which the optic nerve passes, leads into the cranial cavity. In the inner corner in front the cavity

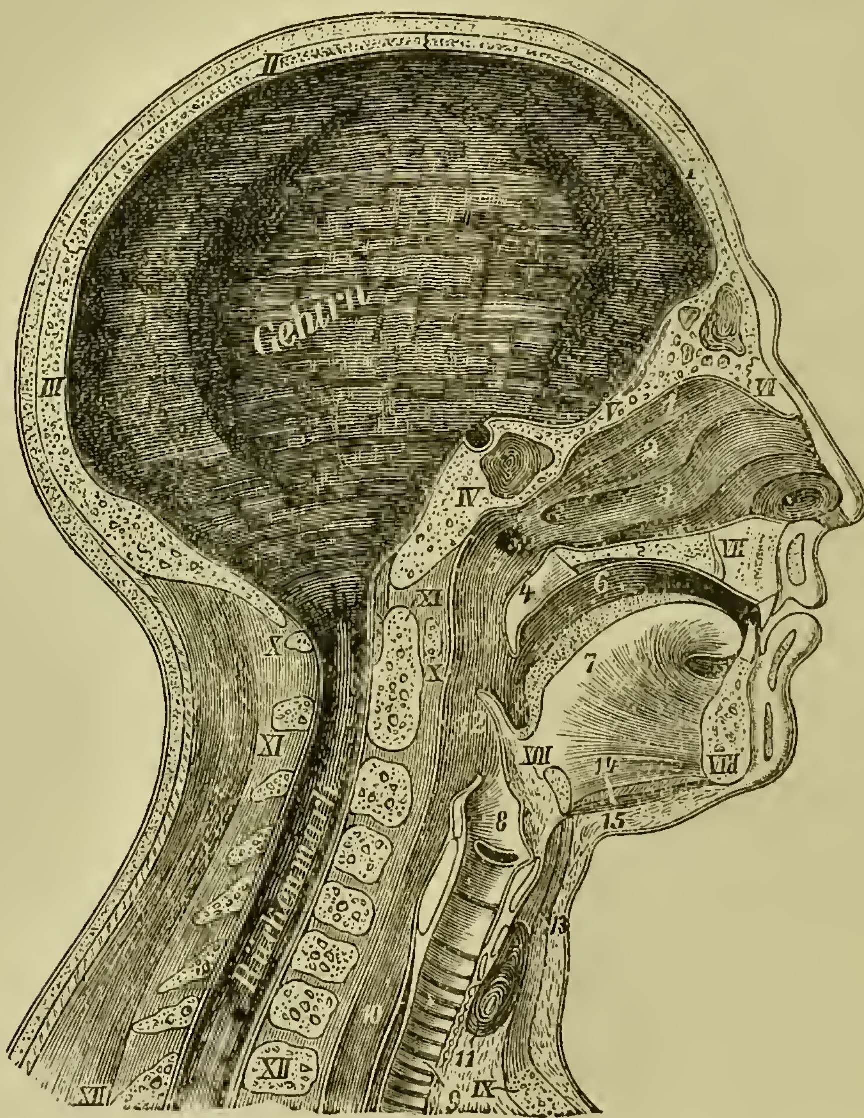

Fig. 2. Head and Neck.

I–V. Cranial Bone (I. Frontal Bone. II. Parietal Bone. III. Occipital Bone. IV. Sphenoid Bone. V. Optic Bone). VI. Nasal Bone. VII. Upper Jaw. VIII. Lower Jaw. IX. Breastbone. X.–XII. Vertebræ. XIII. Hyoid Bone. 1–3. Turbinated Bones. 4. Soft Palate with Uvula. 5. Orifice of the Eustachian Tube. 6. Mouth. 7. Tongue. 8. Larynx. 9. Windpipe. 10. Æsophagus. 11. Thyroid Gland. 12. Epiglottis. 13, 14. Muscles of the Neck. 15. Skin.

of the eye is connected with the nasal cavity by means of the slender lachrymal duct.

The nasal cavity is divided by a partition partly bony, partly cartilaginous, into two halves, open before and be-

hind. The back part of the nasal cavity is continuous with the pharynx into which the cavity of the mouth also leads.

The cavity of the mouth is above divided from the nasal cavity by the palates, of which the anterior bony or hard palate is distinguished from the posterior movable section or soft palate. The floor of the mouth is formed of tissues enclosed by the hyoid bone. The teeth project from

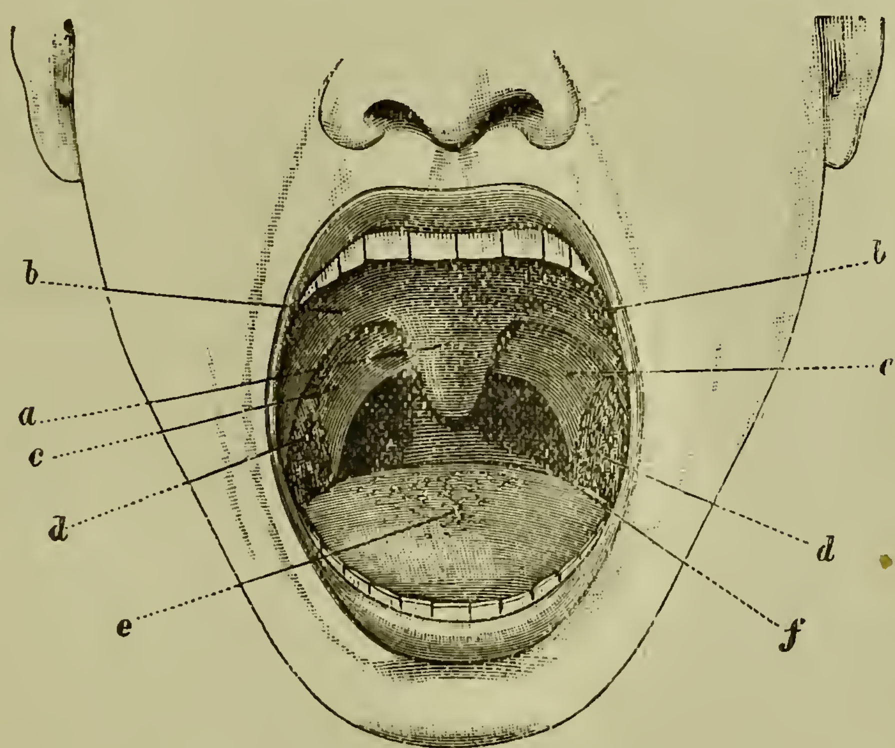

Fig. 3. Structure of the Mouth.
a. Uvula. *b.* Anterior. *c.* Posterior Palatine Arch. *d.* Tonsils. *e.* Tongue. *f.* Pharynx.

the upper and lower jaws : in the adult there are 16 teeth above, and 16 below, making 32 in all. They are usually divided in each jaw into four incisors or front teeth, on each side of which are an eye tooth and five jaw teeth. The hindmost jaw teeth, which usually appear only at the age of 16, are called wisdom teeth. In every tooth we must distinguish the visible crown of the tooth, whose most important constituent is the enamel, from the root of the tooth imbedded in the jaw : the connection

between crown and root is called the neck of the tooth. In its interior the tooth contains the soft pulp which is traversed by blood vessels and sensitive nerves. Behind the teeth is the tongue, whose hindmost part, with the soft palate, bounds the narrowest portion of the cavity of the mouth. If the tongue is pressed down, one notices at the back of the mouth the uvula hanging from the centre of the soft palate ; at the two sides the anterior and posterior arch of the palate ; and on each side of the palate, the tonsils. Under the tongue lie two bluish transparent salivary glands: two other salivary glands are placed on each side on the lower edge of the under jaw, and in front of the extremity of this bone near the ear. The clear saliva secreted by these six glands is mixed with the phlegm present in the mucous membrane of the mouth.

§ **9. Trunk and its Cavities.** The trunk finds its chief support in the spinal column (also called back bone): this runs from the head to the pelvis, and is composed of 24 individual vertebræ, namely, 7 cervical, 12 dorsal, and 5 lumbar vertebræ. At its lower end the spinal column merges in the back of the bony pelvis, the 'os sacrum.' Each vertebra consists in front of the vertebral body and behind of the vertebral aperture enclosed by the vertebral arch, and of several bony projections, which may be externally felt in the middle line of the neck and back. The vertebral cavities of the spine lie close above one another, and form together with the cavity of the 'os sacrum,' the reed-shaped vertebral canal, which by means of the occipital aperture is connected with the cranial cavity and contains the spinal cord.

From the 12 dorsal vertebræ branch off on each side 12 ribs curved like a bow, making 24 ribs in all : they run from back to front in a more or less sloping direction.

The 7 upper ribs on each side are called the true ribs, the 5 lower, the false ribs. The ten upper ribs are connected by cartilaginous continuations (costal cartilage) with the breastbone. The latter is a flat bone which runs downwards in front in the central line of the body from the neck. At its upper end are joined the two collar-bones running to the shoulders. The cardiac region or pit of the stomach is marked out by the lower end of the breast bone and the cartilage of the lower ribs projecting to meet it.

The space enclosed by the 24 ribs in union with the spinal column and the breast-bone forms the thorax or cavity of the chest. Below this lies the abdominal cavity, bounded underneath by the pelvis, behind by the lumbar vertebræ, and elsewhere by tissues, and separated from the thorax by a thin muscular partition, the diaphragm. The pelvis is formed by the 'os sacrum' and the two hip-bones, the latter being joined in front by a cartilage. On the outer side of the hip-bone is a semi-circular hollow for the upper end of the upper leg-bone, the so-called joint-pan: the part of the hip-bone below this hollow is called the 'sitting-bone.' The lowest part of the abdomen enclosed by the pelvis is named the pelvic cavity.

§ **10. The Upper Limbs.** The upper limbs or arms are divided into the upper arm, the lower or fore-arm and the hand. They are connected with the trunk by the shoulders. The bony frame of each shoulder is formed at the back by the shoulder-blade, a flat triangular bone lying in the posterior plane of the trunk; in front by the ⌒‿-shaped collar-bone which projects almost horizontally at the lower edge of the neck to the breast bone; and at the sides by the upper end of the upper-arm bone. This is called upper-arm head, and it possesses a hemispheroidal arched joint, which, with a socket placed on the outer side

of the shoulder-blade, forms the shoulder-joint. Below this between the trunk and the upper arm is the arm-pit.

The bony portion of the upper arm consists of the upper-arm bone, a strong reed-shaped bone, the *humerus*, the lower end of which is distinguishable externally by two sharply-projecting lateral knobs, and forms, with the bone of the lower arm, the elbow-joint. The bony frame of the lower arm consists of the *radius* placed on the same side as the thumb and the *ulna* placed on the same side as the little finger; the hook-shaped upper end of the *ulna* is visible at the back of the elbow-joint. The *radius* can be moved on the *ulna*, and thus makes possible the rotations of the hand that follow its movements.

The hand is divided into the wrist, the middle hand, and the fingers. The bony portion of the wrist is formed by two rows of small bones, the eight bones of the wrist, the upper row of which combines with the lower ends of the *radius* and *ulna* to form the joint of the hand. In the middle-hand it is usual to distinguish the back of the hand and the hollow of the hand: the latter is bounded by the ball of the thumb and the ball of the little finger. The mobility of fingers is effected partly by small hand-muscles imbedded in the middle hand, partly by the muscles of the lower arm, whose long string-shaped sinews stretch through the wrist and hand as far as the finger-bones.

§ **11. The Lower Limbs.** The lower limbs or legs begin at the hips and divide into thigh, leg, and foot. The bony portion of each thigh is the thigh-bone, the strongest and longest bone in the human body. The ball shaped enlargement at its upper end forms with the socket in the hip bone the thigh-joint. The leg (the fleshy back part of which is called the calf of the leg) possesses two bones, viz., the shin-bone on the inner side and the thinner *fibula* on the outer side. The upper end of the

shin-bone forms with the lower part of the thigh bone the knee-joint, in which the flat knee-cap lying in front of the two bones, and connected with them by strong ligaments, also plays a part. The back portion of the knee-joint is called the hough.

The two leg-bones thicken at their lower end into the inner and outer ankle-joints and form with the *astragalus* the joint of the foot. The *astragalus* is one of the seven bones of the *tarsus* of which the heel-bone is the most important.

The foot is formed by the tarsus, middle-foot, and toes, and is divided into the instep and sole. In a standing position the foot rests on the heel, or bone of the heel, and the balls of the great and little toes. So that the outer edge of the foot touches the ground. The balls of the toes and the heel as fulcrums of the foot, possess a very thick outer skin; the part of the sole lying between them is arched slightly upwards, and is called the arch of the foot. In many persons this has sunk down so much that in standing the foot touches the ground with the entire sole and the inner edge of the foot. A foot shaped in this way is called a flat foot. The strong sinew which stretches like a string from the muscles in the calf of the leg to the posterior end of the heel-bone is known by the name of the "tendon of Achilles."

§ **12. The Organs of the Thorax.** (Fig. 4.) The tissues enclosed in the great cavities of the trunk are called viscera. In the cavity of the chest lie the two lungs and the heart.

§ **13. The Lungs and Breathing.** The lungs, of which the right is composed of three, the left of two superimposed lobes, contain numerous very small cavities resembling a sponge. These are called the vesicles of the lungs. From these vesicles proceed elastic tubes,

which join together in wider tubes, and finally open into the great branches of the wind-pipe, one branch of which

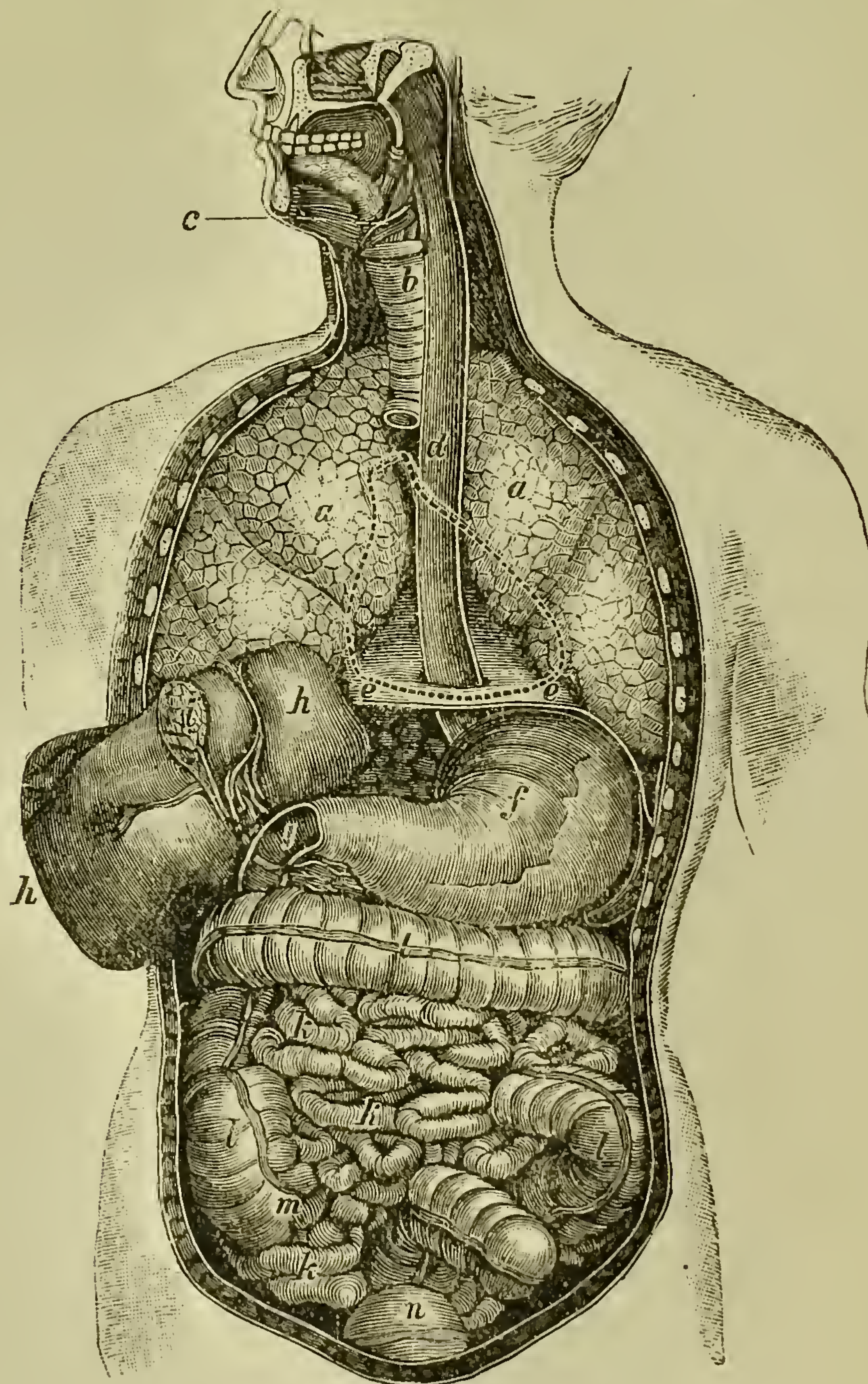

Fig. 4. Thoracic and Abdominal Viscera in Man.
a. Lungs. *b*. Windpipe. *c*. Larynx. *d*. Æsophagus. *e*. Diaphragm. *f*. Stomach. *g*. Duodenum. *h*. Liver. *i*. Gall-bladder. *k*. Small Intestines. *l*. Large Intestines. *m*. Cæcum. *n*. Urinary Bladder. The dotted line shows the outline of the Heart, which is not shown for the sake of clearness.

leads to each of the five lobes of the lungs. Two wide tubes, one of which receives the three branches of the right

lung, the other, the two branches of the left lung, join together in the windpipe. The latter lies in the central line of the neck, and at its upper end passes into the larynx, which opens into the fauces, and thus is connected with the outer air by the apertures of the nose and mouth. The outer surface of each lung is covered by a fine membrane the *pleura pulmonalis*. The interior of the chest is similarly lined with the *pleura costalis*.

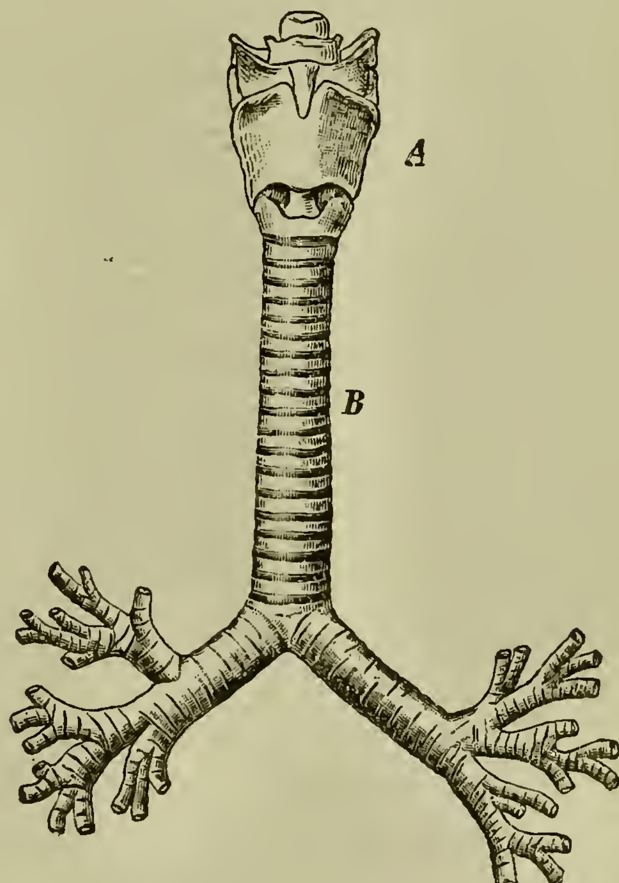

Fig. 5.
Larynx (*A*), and Windpipe (*B*), with its branches.

By the continuous activity of the lungs, called breathing, the air which man requires in order to live is introduced into the body. We must distinguish between inspiration and expiration. In inspiration the air from without passes through the windpipe and its continuations into the expanding lung-vesicles, and thus the lungs are inflated like a bellows. In expiration, the used-up air is driven out from the lung-vesicles, and the expanded lungs sink down again. To inspiration and expiration correspond the regular breathing motions of the chest, which are perceptible as expansion and contraction as well as rising and falling of the chest. The air expired is warmer than the air inhaled. It contains less oxygen than the latter, but on the other hand is richer in carbonic acid and moisture. Its greater admixture of

water is perceptible by the fact that cold objects, as mirrors, become dulled when breathed upon, and also that the breath issuing from the mouth congeals in cold weather to visible mist. The number of respirations for an adult man is from 16 to 18 per minute, but this is increased in rapid walking or running, in ascending stairs or hills, and also in several diseases. Children when in good health or at rest, breathe more frequently than adults.

§ **14. The Larynx, Voice and Speech.** In the act of expiration tones can be produced at will in the larynx, which constitute the voice. The larynx, whose cartilaginous walls may be felt in the neck, contains in its interior the two vocal cords extending close to each other from front to back. These, when at rest, are relaxed, and lie so wide apart that a large opening between them allows free passage to the breath ; yet by means of small muscles placed in the larynx, they can be contracted and brought near each other. The exhaled air in its passage across them sets them vibrating, and thus produces, according to the tension of the cords, higher or lower tones which may be observed in speaking or crying, but most clearly in singing. With the aid of the tongue, the palate the teeth and the lips, man can mould his voice into speech.

§ **15. The Blood, Blood-vessels, Heart and Circulation.** A portion of the inhaled air mixes itself inside the lungs with the blood which courses through the body in unceasing circulation.

The blood is red and viscous. It consists of the colourless blood fluid (plasma) and the numerous little blood-corpuscles, only visible by the aid of the microscope (Fig. 6). By far the greater part of these are shaped like a coin and have a gold red colour (red corpuscles), a smaller

number are spherical and colourless (white corpuscles). Outside the body the blood generally coagulates, since a gelatinous mass and the blood water (serum) separate from each other.

The blood is to be found partly in the heart, partly in the sack-shaped blood-vessels. The larger blood-vessels have elastic sides, they are divided into arteries in which the blood flows from the heart to the tissues, and veins which bring back the blood from the tissues to the heart.

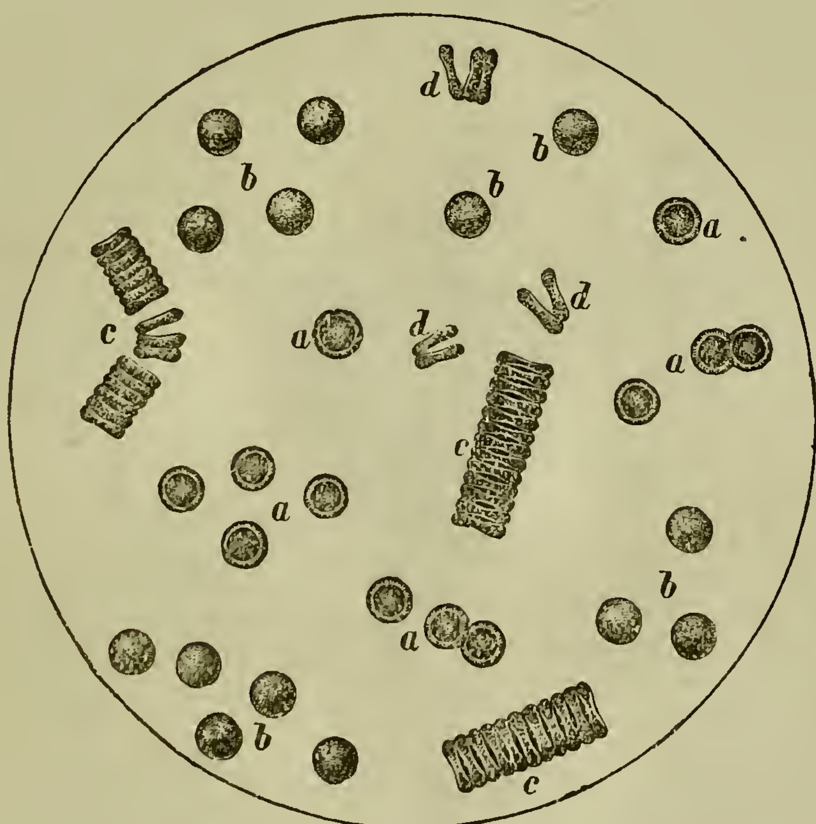

Fig. 6. Blood Corpuscles, greatly enlarged.

a. Red *b.* White Blood Corpuscles. *c.* Red Blood Corpuscles, lying beside each other like a pile of coins. *d.* The same singly viewed laterally.

The Heart (Fig. 7) surrounded by a skin-like substance, the *pericardium*, lies in the front portion of the left half of the thorax. It is about as big as the fist of the man to whom it belongs; in shape it resembles a cone, whose base lies behind the central part of the breast-bone, and

whose apex touches the anterior costal wall in the interval between the fifth and sixth left ribs, at a distance of a hand's breadth from the lower third of the breast-bone. While the anterior wall of the heart lies close to the wall of the chest for the most part, the posterior wall and portion of the upper and outer edges is covered by the left lung. The heart consists of muscular masses and encloses a cavity which is divided into four sections by one partition running vertically and another running horizontally. The two upper sections lying close to the base are called the right and left auricle; the two lower which are closer to the apex, the right and left ventricle. Each auricle is con-

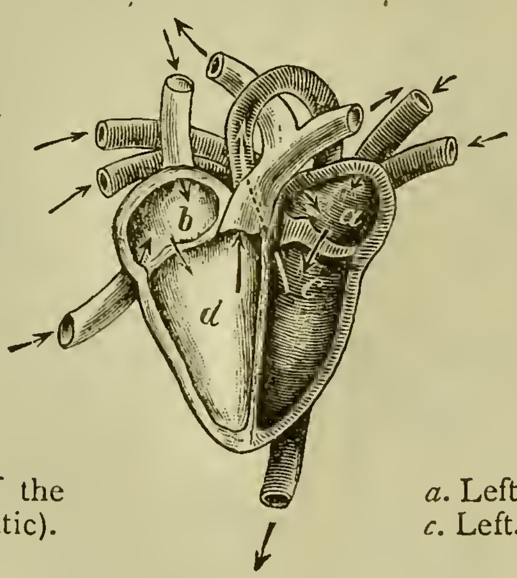

Fig. 7. Section of the Heart (Diagramatic).

a. Left. *b*. Right Auricle.
c. Left. *d*. Right Ventricle.

nected with the corresponding ventricle by an orifice in the horizontal partition.

From the left ventricle of the heart proceeds the great artery of the body, or aorta. This runs upwards at first then makes a bend backwards to the spinal column, and runs downwards in front of this to the pelvic cavity, where it divides into two arteries for the two lower limbs. At the bend the arteries for the head, neck, and upper limbs run upwards, and the arteries for the organs of the thorax and abdomen branch off from the aorta in its downward

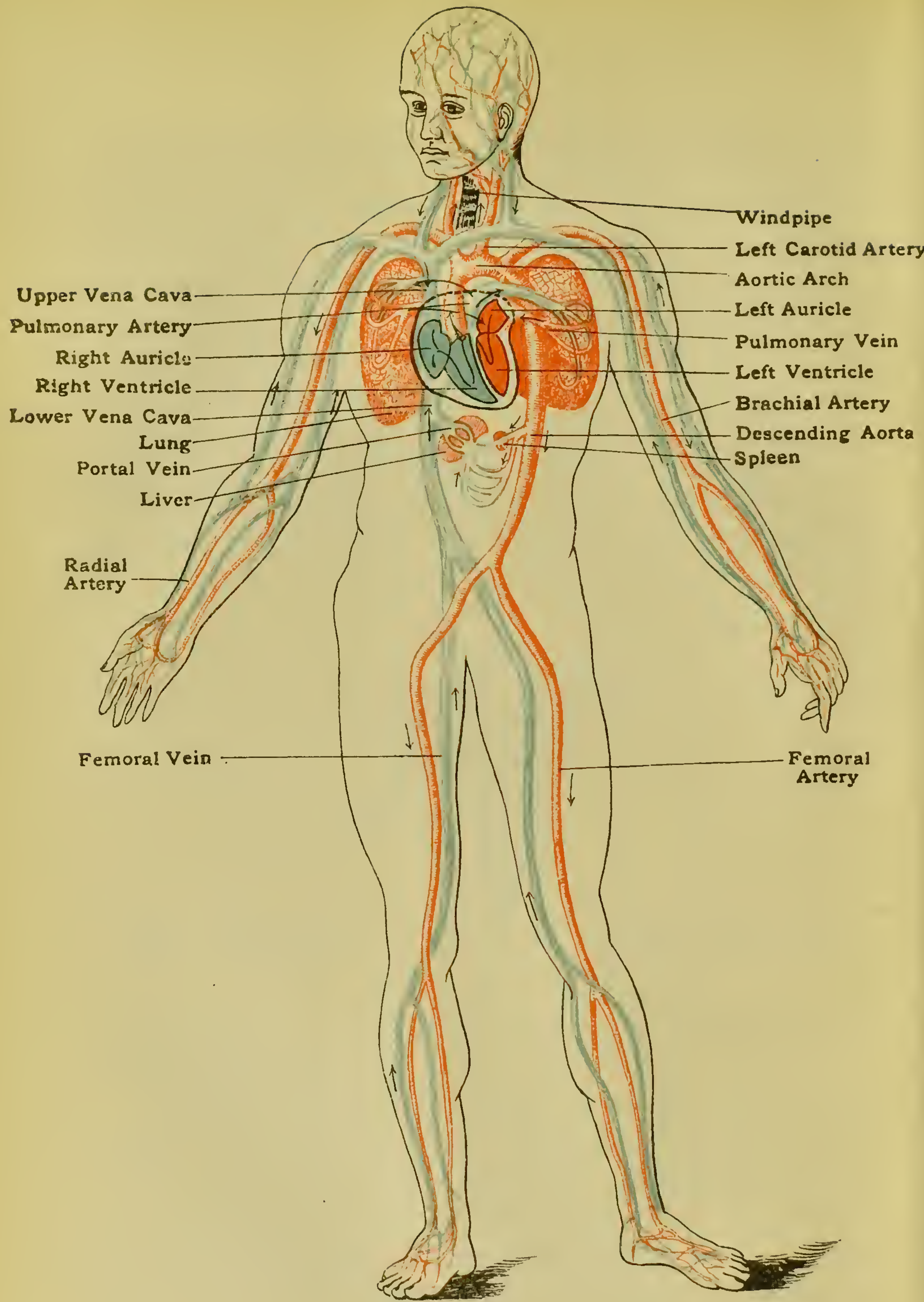

Fig. 8. VASCULAR STRUCTURES.

The red vessels are arteries, the blue veins, but the pulmonary artery is coloured blue, and the pulmonary vein red, on account of the character of the blood carried by these vessels.

passage. The arteries divide into branches, these again into still smaller branches, till finally very minute arteries or capillary vessels, only visible by the microscope, result, which are spread like a dense network over the entire body. Through combination of the capillary vessels are formed the small veins, and from the union of the latter the large veins. The latter finally unite in the two great *venæ cavæ*, of which the upper brings back the blood from the neck, head and upper limbs, and the lower the blood from the rest of the body and pour it into the right auricle of the heart. The portion of the blood circulation so far described between the left ventricle and the right auricle of the heart is called the great or systemic circulation (Figs. 8 & 9).

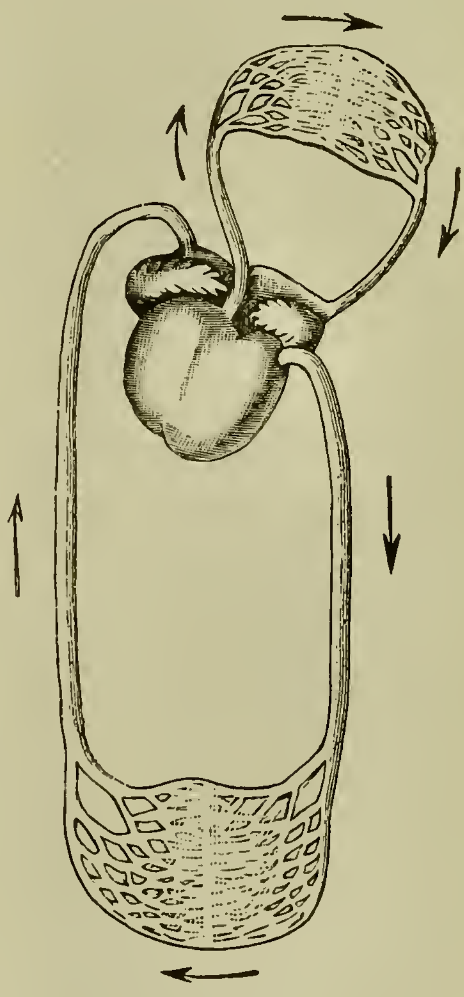

Fig. 9.
Circulation.

From the right auricle the blood passes into the right ventricle; then it enters the pulmonary artery, proceeding from this into the small or lung-circulation. The pulmonary artery divides just like the arteries of the rest of the body, into gradually smaller branches; the capillary vessels of the lungs unite in the pulmonary veins by which the blood is brought back to the left auricle and thus to the great circulation.

§ **16. Relations of the Circulation of the Blood to Respiration.**—The circulation of the blood is effected by the contractions of the heart; these

occur in the adult man about 72 times per minute, less frequently in old age, more frequently in children, and they affect in regular alternation the auricles and the ventricles. As soon as the auricles contract, the blood flows from them, as from a squeezed india-rubber ball, into the ventricles, at the same time the ventricles expand, and as it were, suck in the blood from the auricles. As soon as the ventricles contract, the blood taken up by them flows into the arteries and expands the latter.

During the contraction of the ventricles, the apertures in the cross-membrane between them and the auricles are closed by a valve-arrangement so that the blood that has already passed from the auricles cannot flow back again. Other valves prevent a reflux of the blood from the systemic and pulmonary arteries into the ventricles of the heart. By many diseases the valves are so changed in shape that they are no longer capable of closing ; such defects in the valves of the heart may lead to obstructions in the circulation, since the blood on the expansion of the auricles or ventricles partly flows back into them, expands them immoderately, and blocks up the veins.

Each contraction of the heart occasions a gentle motion of the chest, especially at the apex of the heart ; this is the heart-beat, externally visible and palpable in many men. From the influx of blood expanding the arteries, results the beating of the pulse which may be perceived by gentle pressure of the finger tips in the superficial arteries, *e.g.*, in the radial artery at the wrist. The strength and frequency of the pulse is altered in mental excitement and in many classes of sickness, for instance, in fever an increase in the number of pulse-beats is usually observed.

During the circulation a change takes place in the colour of the blood, connected with the respiration. A part of the oxygen contained in the inhaled air is taken up into the

blood by means of the capillary vessels of the lung-vesicles which allow a passage for the oxygen of the air; this oxygen combines with the colouring matter of the blood contained in the red corpuscles, and thus produces the clear scarlet-red appearance of the blood. This colour is preserved while the blood flows through the left auricle, the left ventricle, and the arteries of the body; in the capillary vessels of the great circulation the oxygen is given up by the blood to the surrounding tissues, and an approximately equal quantity of carbonic acid is received instead, from which the blood acquires a blackish red appearance. Thus coloured, the blood flows through the veins, the right auricle, ventricle, and the pulmonary arteries, in order to exchange the carbonic acid it has received for a fresh supply of oxygen. The carbonic acid which is removed through the lungs by exhalation is produced in the tissues of the body by a process similar to combustion.

§ **17. Lymph, Lymph-vessels and Lymph-glands.**—In addition to the arteries and veins that convey the blood, the human body is traversed by another class of vessels, which contain a colourless fluid named "*lymph*," and which are called *lymph-vessels or absorbents.* Their very fine terminals extending everywhere through the body, absorb their contents from the bodily tissues, and convey it into the upper *vena cava* by means of a great lymph-vessel stretching upwards in front of the spinal column through the thorax. This vessel has a diameter of about 0·5 c.m. Along the course of all the lymph-vessels are inserted the lymph-glands. These vary in size from a pin's-point to a bean, and contain in their interior numberless small cells resembling the white blood-corpuscles; the lymph flowing between these cells leaves behind it, as in a filter, any impurities it may have carried with it. Such impurities, if composed of injurious matter absorbed from diseased

bodily tissue or from wounds, lead to a swelling of the lymph-glands.

§ **18. Viscera of the Abdomen.**—(Fig. 4). The viscera of the abdomen comprise the organs of digestion, the organs for the secretion and egress of the urine, and the spleen. The organs of digestion are the *stomach*, the *intestinal canal*, the *liver* and the *pancreas*.

§ **19. The Stomach, Alimentary Canal, Intestinal Canal.**—The stomach is a long sack with sides resembling skin ; it lies cross-wise immediately below the diaphragm, its front close to the cardiac region or pit of the stomach. The more spacious part of the stomach on the left side is joined above, at the back to the gullet, which is the connecting link between the mouth and the stomach. It is a tube about as thick as one's finger, with elastic sides ; it passes in front of the spinal column, behind the wind-pipe at the neck, between the great blood vessels in the thorax until it reaches the diaphragm, and penetrating the latter, opens into the stomach. On the right the stomach narrows like a funnel as it reaches its continuation behind, in the bowels. The point of transition (which at times is gripped together so firmly by a muscle surrounding it like a ring, that the cavity of the stomach is shut off from the interior of the bowels as if by a valve), is called the *pylorus*.

The intestinal canal is shaped like a tube, with membraneous sides, and is, perhaps, six times as long as the human body. It is divided into the narrower intestines, and the wider "great gut." The narrow intestines (whose uppermost part continuous with the stomach, about twelve fingers in length, is called the "*duodenum*,") fills with its many folds the greater part of the abdomen. In the lower part of the abdomen on the right, just above the hip-bone, it opens into

the great gut; the first part of the latter lying immediately below the soft covering of the abdomen, forms a sack-shaped projection, the "*cæcum*." To this is joined the *veriform* process, a portion of the great gut, about a finger in length and somewhat thicker than a large earth-worm. The "cæcum" and veriform process sometimes develop an inflammation that seriously threatens the life of the individual, in many cases indigestible bodies, such as cherry-stones, which pass accidentally into the veriform process are the causes of such attacks. From the "cæcum" the great gut ascends; then it turns from the front wall of the stomach to the left side of the abdomen, then descends into the pelvis, and enters the latter as the "*rectum*," which rests on the "*os sacrum*," in order finally to open outwards as the posterior orifice.

The greater part of the intestinal canal, like most of the viscera of the abdomen is covered on the outside by a fine skin called the "*peritoneum*," which also covers the inner surface of the abdomen. Between the peritoneum covering the intestines and the sides of the abdomen there are many connections in the shape of ligaments or membranous folds, which steady the intestines and hold them in position: these connections are called the "*mesentery*." In the fore part of the abdomen immediately behind the abdominal wall is placed the *omentum*, a membranous body hanging down loosely in front of the intestines like an apron: in corpulent people this is largely loaded with fat.

§ **20. The Liver, Gall-Bladder, and Pancreas.**—The *liver* (the upper half of which has been omitted in Fig. 4, in order to exhibit the organs covered by it) fills the upper part of the abdomen on the right of the stomach below the diaphragm. It is a large brownish-red organ composed of several lobes; its substance is nearly solid, its upper surface being arched and its lower some-

what more level. The gall, a bitter yellow or brown fluid which becomes green if exposed to the air, is separated by the liver. The bile collects at first in the pear-shaped gall-bladder projecting from the under surface of the liver, and is then passed through a fine conduit into the duodenum. At the same place another fluid enters the interior of the bowels; this is the pancreatic juice resembling saliva, the pancreas being a long flat organ placed directly behind the stomach.

§ **21. Digestion and Assimilation.**—The machinery of digestion, as may be seen by the preceding description, consists on the one hand of a canal beginning at the opening of the mouth, traversing the greater cavities of the trunk and ending at the posterior orifice, and on the other hand of certain glands whose secretions are poured into the interior of this canal. The food and drink which we enjoy, are digested during their passage through this canal—that is the nutritive substances in them which are necessary for the growth and preservation of the body, are here separated from the food and dissolved, in order by the agency of the lymphatic vessels, to be taken up into the blood-fluid, while the useless matter of the food is expelled from the body through the posterior orifice as excrement.

Among food-stuffs a distinction is drawn between food containing sugar or starch, albuminous food and fats. Of these the starchy foods are especially digested by the saliva of the mouth and pancreas, but the albuminous food by the acid gastric juice secreted by the small glands of the mucous membrane of the stomach. The reduction of the fats to a soluble form is accomplished by the agency of the bile.

The dissolution of the food is aided by its diminution in size, a process already begun in the mouth where the teeth masticate it. The food is next swallowed into the

gullet and the stomach by means of the movements of the tongue, the soft palate, and the gullet-muscles, situated in the pharynx; at the same time, the epiglottis, connected with the base of the tongue, closes, and prevents the entrance of the food into the larynx and windpipe (swallowing the wrong way). As soon as the stomach has received the food, it begins to discharge the gastric juice, and by rotatory motions to thoroughly mix and stir up its contents. At the same time the "pylorus" closes, so that an immediate passage of the food into the intestines is impossible. Only after the digestion in the stomach is completed (which according to the quality of the food occupies from one to six hours) does the pylorus allow the food, now reduced to a thin pulp to pass into the intestines. Here the addition of the bile, of the pancreatic juice, and of the juice secreted by the small glands in the mucous membrane of the intestines, effect an almost complete fluidity of what is called, the "*chyme*." The fluid thus produced (coloured brown by the bile), is by the aid of a movement in the intestines similar to the contortions of a worm, gradually forced through the small intenstines, assumes in consequence a more and more pulp-like, and then a viscious character, and finally changes inside the great gut into the still more solid excrement.

This gradual thickening of the contents of the intestines is the result of a transference of its fluid constituents to the circulating streams of blood and lymph; for in the small intestines the lymph-vessels in their mucous membrane absorb as a milk-white fluid, the "*chyle*" which they carry into the great lymph-vessel and so into the track of the blood. The "chyle" is carried by the blood to the cells of which the tissues of the body are composed, and is assimilated by them in order to be applied partly in the formation of new tissue, partly in preserving the old cells.

For the nutrition of the individual cells, which lies at the basis of all the functions of life, requires an unceasing consumption of the chemical matter of which the body is constructed. Thus a process similar to combustion is carried out: the chemical constituents of the cells of the body are by the help of the oxygen supplied by the blood, converted into more simple chemical compounds, especially into carbonic acid, water, and a residue corresponding to the ash of combustible bodies. Combustion and the cellular functions are distinct, in so far as the former generally takes place with the production of light, the latter generally without it; however, the production of heat, together with the consumption of the material employed, is common to both. As for the maintenance of every combustion, a constant supply of combustible material is necessary, so, for the continuance of the cellular functions of our body, without which life would be impossible, new cellular tissue supplied by the chyle is indispensable.

The unceasing consumption, and replacing of the consumed food by the aid of the supply of oxygen and nourishment, through breathing and digestion, is called the assimilation of the living body.

§ **22.**—The heat produced by the activity of the cells is distributed by means of the blood in almost uniform fashion over the entire body. Thus the body preserves an independent heat, which in the course of the day varies only about 0·1 C., and in a healthy man stands on the average at about 37·0 C. Any considerable increase in temperature is prevented by the fact that a part of the bodily heat is constantly being given off to the surrounding atmosphere (1) from the surface of the body; (2) with the exhaled breath; (3) with the secretions. Occasionally this diffusion of heat is increased still further by perspiration, inasmuch as moisture thereby produced on the surface of the skin

acts as a withdrawer of heat. In summer, if the air is so warm that the body cannot cool itself sufficiently by diffusion of heat from its surface, then the glands of the skin give out more perspiration than at the other seasons of the year. An immoderate cooling of the body is obviated by the clothing, which in our climate protects the surface of the skin from the effects of the colder air.

The heat of the body may be increased by sickness, and also temporarily by vigorous muscular efforts ; if it is raised to 41·5° C., and upwards, death as a rule is the result. In severe exhaustion and similar states, the temperature of the body sinks to 36° C., sometimes even lower ; the cessation of the cellular function after death causes a rapid cooling of the body.

§ 23. Urine, Kidneys, & Urinary Canal.—After the decomposition of the bodily constituents connected with the cellular nutrition, certain waste substances remain behind which pass at once into the blood, namely the carbonic acid, water, and so-called salty constituents. A part of the water escapes with the carbonic acid in the exhaled air ; the rest of the water not required in the body passes out of the organism in the form of sweat, and of urine, together with certain salty constituents which it helps to hold in solution.

The urine of a healthy person is a clear fluid, coloured sometimes bright yellow, sometimes dark or reddish yellow, according to the proportion of water it contains. In the open air it soon putrefies owing to the formation of ammonia, and becomes muddy. As in ill-health the urine frequently contains cellular and other matter, as well as sugar or dissolved albumen, its chemical or microscopical examination often gives the physician a clue to the nature of the illness.

The urine is secreted by the two kidneys which are greyish

or brownish-red, bean-shaped glands, from 10 to 15 centimetres long; they lie, imbedded in rich fatty tissue, close to the posterior wall of the abdomen, on each side of the lumbar vertebræ. From the hollow of each kidney the urinary duct leads to the bladder, which lies in the pelvic cavity in front of the rectum. From the bladder the urine is from time to time emptied externally.

§ **24. The Spleen.**—Besides the organs of digestion and the urinary machinery, the abdomen also contains the spleen—a long flat organ of a bluish-red colour, and rather firm substance which plays a part in the formation of the blood. The spleen lies on the left of the stomach, between the diaphragm and the left kidney; it is usually completely covered by the lower ribs. Still in many diseases it increases in size so much that its edge can be felt on the side below the last rib through the covering of the abdomen.

§ **25. Action of the Nerves, Brain and Spinal Marrow.**—While the circulation of the blood, breathing, and digestion, are accomplished regularly and unconsciously without being influenced by the will, there are other living functions of the body which require the presence of consciousness and in part display the activity of the will. These are the sensations, by means of which we are conscious of the objects and events surrounding us and a large part of our movements.

The capacity for sensation and voluntary movement is connected with the possession of the nerves and the great organs belonging to them. The brain, and the spinal marrow, form the central point of the activity of the nerves.

The brain (Fig. 10) forms the contents of the cranial cavity; it is surrounded by several membranes, partly hard, partly soft, and it is composed of a mass of soft tissue, traversed by numerous blood vessels for the most part narrow

and elastic. In the mass of the brain the superficial thin and greyish cortex is distinguished from the more extensive white matter; the latter contains in its interior several grey-coloured patches, and some cavities connected with each other containing a watery fluid. The whole organ is divided by a cross fissure into an anterior, larger part, the great brain (cerebrum), and a smaller part, the

Fig. 10. Position of the Brain.
A. Great Brain. *B*. Little Brain.

little brain (cerebellum) occupying the posterior lower section of the cranial cavity. A longitudinal fissure divides the large and small brain into right and left halves. Moreover the brain is divided into so-called lobes, which are named according to their position, frontal, middle, temporal and posterior; each lobe consists of several convolutions. Between the lobes and convolutions irregular

peculiarly-crooked furrows are traced on the surface; some penetrate more deeply into the mass of the organ, like the great longitudinal and lateral fissures.

The spinal marrow partly fills the vertebral canal; like the brain it is surrounded by membranes, is of a cylindrical shape, and is formed of soft nervous tissue, white outside and grey inside. At its upper end (the so-called 'medulla oblongata') it enters the cranial cavity, where it is immediately connected with the brain: the cavities of the brain are continued into the canal of the spinal marrow, which traverses the latter from top to bottom.

In the grey matter of the brain and spinal marrow are numberless structures, only visible to the microscope, known as the "ganglion-cells." From the peculiar ends of these cells proceed minute nerve filaments, which sometimes join together in white bundles called nerve-fibres. The nerve-fibres constitute the white matter of the brain and spinal marrow; they are scattered in all directions through the brain, but run lengthwise through the spinal marrow like close bundles of strings. The nerves are formed out of the nerve-fibres, and as white, firm strings, varying in thickness from a knitting-needle to a quill, proceed from the brain and spinal marrow, split into single bundles and filaments owing to continuous division and bifurcation, and finally terminate in the various parts of the body in the shape of minute papillæ, only visible by the microscope.

The ganglion-cells of the brain are the seat of consciousness: in them our sense-images are formed, and the will, which guides our actions, has its origin there. The nerves act as transmitters between the ganglion-cells whence they proceed, and the different parts of the body which experience the sensations and execute the movements directed by the will. The destruction of single parts of the brain, which may occur as the result of

external injuries, or from the bursting of blood-vessels in the brain (apoplexy), causes the loss of certain definite capacities of sensation or movement, according to the seat of the injury, owing to the interruption of the nerve-connection or the annihilation of the ganglion-cells. Thus, on the destruction of a certain convolution in the left frontal lobe of the great brain, a man loses the faculty of forming words : lesions of other neighbouring parts of the brain result in loss of power of the limbs : even the faculties of sight or hearing may be lost by injury to definite parts of the brain. Similarly, the functions of single parts of the body will be made impossible by the severance of the nerve connecting it with the brain : thus, the cutting of an optic nerve causes immediate blindness in the eye with which it is joined.

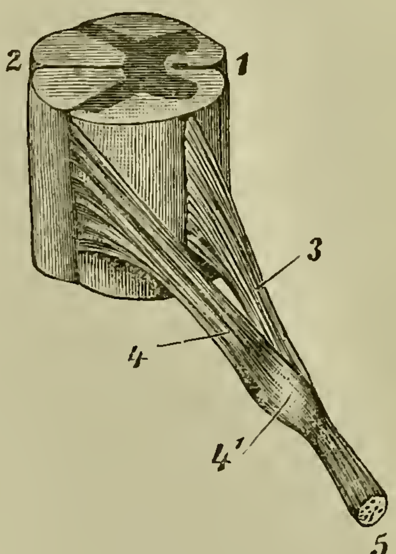

Fig. 11.
Origin of a Spinal Nerve.
1, 2. Spinal Column.
3, 4. Roots of the Nerve.
5. Nerve.

Of the single nerves the most important are the twelve pairs of cerebral nerves which issue from the cranial cavity through definite apertures in its osseous covering. Some of them, like the nerves of smell, sight, hearing, and taste convey sense-perceptions to the brain; others are motor nerves like the nerves to the muscles of the eye, and the face, and the two nerves of the tongue.

From the spinal marrow proceed thirty pairs of spinal nerves, each of them has an anterior and posterior root (Fig. 11). Through the posterior root issue those nerves which convey sensations to the spinal cord and brain ; the anterior root is composed of those nerve-filaments running from the brain and spinal cord to the organs of

movement. Through the lesion or destruction of the posterior root of a vertebral nerve certain parts of the body lose their sensibility, while similar lesions in the anterior root result in the loss of power of definite muscles.

§ **26. The Organs of Sense.**—For the reception of the sensations produced by external impressions and conveyed to the brain by the nerves, the body possesses special sense-organs of sight, hearing, smell, taste and touch.

§ **27. The Sense of Sight—The Eyes.**—The organs of the sense of sight are the two eyes, which may be divided into the eyeballs and their auxiliary and protective contrivances.

The eyeballs (Fig. 12) lie in the cavities of the orbits, imbedded in soft fatty tissue; in shape and size they resemble large cherries. They are joined to the brain by the two optic nerves, each of which passes from the cranium through an aperture into the cavity of the orbit and enters the posterior wall of the eye, where it splits into nerve-filaments. In each eyeball can be distinguished a firm coating like the rind of a fruit, and a gelatinous transparent fluid, the *vitreous humour*. The coating consists of three layers. The outer layer is formed by the porcelain-white and firmly-fixed *sclerotic*, which acts as a protective covering for the inner parts of the eyeball. A portion of its anterior surface is known as the white of the eye. The middle layer is the *choroid*, a soft tissue, coloured black on its inner surface, in which the blood-vessels running to the eyeball branch out in various directions. The inner layer is the *retina*, a fine very soft network of the filaments of the optic nerve. In the anterior surface of the sclerotic is a circular slightly convex transparent division, the *cornea*, through which the light falls into the interior of the eye, as

through a window. The portion of the choroid lying behind does not touch the cornea, but there is, as it were, a curtain stretched between the space formed by its convexity (the anterior chamber) and the interior of the eye. This part of the choroid coat is called the "*iris*," because it is differently coloured in different individuals. According to its colour we speak of, grey, blue, brown or black eyes. The "iris" has in its centre a round aperture, the *pupil* of the eye, which appears as the black spot in the eye. According as the pupil dilates or contracts, it allows more or less light to pass into the interior of the eye The iris therefore affords a contrivance for shutting out too strong a light by contraction of the pupil. Behind the pupil, immediately in front of the vitreous humour, lies the *crystalline lens*, a body formed of transparent compact tissue, which is curved in front and back like a magnifying glass. The crystalline lens combines the rays of light passing through the cornea and pupil on the background of the eye, into an image, which is perceived by the retina.

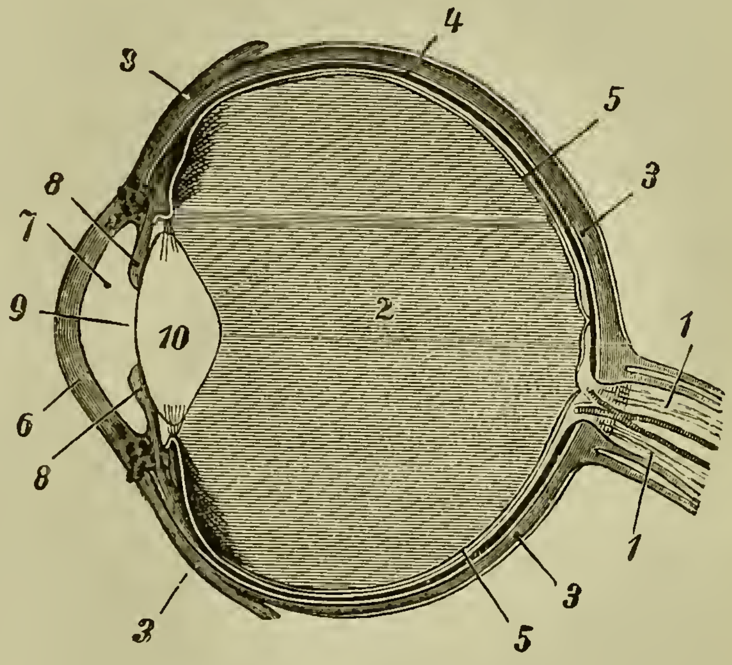

Fig. 12.

Section of the Eye Ball (enlarged).

1. Optic Nerve. 2. Vitreous Humour. 3. Sclerotic. 4. Choroid. 5. Retina. 6. Cornea. 7. Anterior Chamber. 8. Iris. 9. Pupil. 10. Crystalline Lens.

By the ordinary convexity of the lens only rays of

light passing parallel into the eye are combined on the back-ground of the eye, while rays entering obliquely are focussed behind the back of the eye. As only rays coming from some distance, strike the eye in parallel lines, the lens possesses the faculty of increasing its convexity by a muscular effort, so as to focus the rays coming obliquely from the near distance on the background of the eye. There are, however, eyes of so small a diameter that the lens must increase its convexity in order to focus parallel rays on the retina, but is unable to focus oblique rays on the back of the eye, and the image produced on the retina is thus rendered indistinct. Such eyes are called "over-sighted." Their power of vision can be improved by an artificial lens, supplementing the action of the crystalline lens, in the shape of a double-convex spectacle-glass placed in front of the eye. Other eyes are constructed with such a long diameter that the focussing of the parallel rays takes place before they reach the back of the eye, and such eyes are only capable of receiving clear images of near objects. Since rays coming from near objects strike the eye obliquely, and are therefore focussed at a greater distance from the lens than parallel rays. Such eyes are called short-sighted, and their visual capacity is improved by the use of double-concave spectacle glasses ; the latter scatter the rays of light before they arrive at the eye.

With the approach of old age the power that the lens possesses of focussing itself for rays coming from near objects, usually decreases gradually. The visual point, *i.e.*, the smallest distance at which the eye is able to see an object plainly, is always receding more and more ; the eye can, relatively speaking, perceive well only very distant objects ; it becomes long-sighted. In popular phraseology this term is applied, not quite correctly, to "over-sighted" eyes.

A greyish dimness of the lens, arising from injuries to the eye, or from illness, and especially from extreme old age, diminishes or destroys the visual power of the eye, and is called "*cataract.*" Persons attacked by cataract can recover their faculty of sight when the opaque portion of the lens is removed by an operation, but they must constantly wear highly-convex spectacles in place of the lens that has been taken away.

The eyeball can be moved in several directions by the muscles lying with it in the cavity of the orbit, and hence can be directed towards different objects in quick succession. A wider field of vision is made possible by the movements of the head. As soon as both eyes are simultaneously directed to a near object, they regard it from different sides, and thus the shape of the body is more easily imaged in the brain. When looking straightforward, the muscles of the eye are in a state of counterpoise, that is, the action of the muscles on the inner side of the eyeball is counterbalanced by the action of those on the outer side. A destruction of this counterpoise, produced by several causes gives rise to squinting. For example, if the outer muscle of the eye is weak, or if the inner muscle is shortened, the direction of the eye affected will be inwards, and an inward squint makes its appearance.

The eye is preserved from external injuries by certain protective arrangements. The eyelids especially protect the eyeball from the intrusion of foreign bodies (*e.g.*, insects), and prevent by means of the fine hairs on their edges (the eyelashes) dust and other substances from passing into the eye. The surface of the lids next to the eye is covered by a membrane the so-called "*conjunctiva*," which is continued over the anterior surface of the eyeball. The lachrymal fluid serves for the removal of particles of dust, which, in spite of the protection of

the lids and eyelashes, have penetrated into the space between the lids and eyeball.

This fluid is secreted by the lachrymal glands, lying in the cavity of the orbit on the outer side of the eye, and passes over the conjunctiva whence it usually flows through the lachrymal duct into the nasal cavity. An increased secretion of the lachrymal fluid takes place in weeping. Also when the conjunctiva becomes red from inflammation, swells up and freely discharges "pus" or matter, a "running of the eyes" is the result since the fine apertures leading to the lachrymal duct become then more or less impassible, and thus the efflux of lachrymal fluid into the nose is stopped.

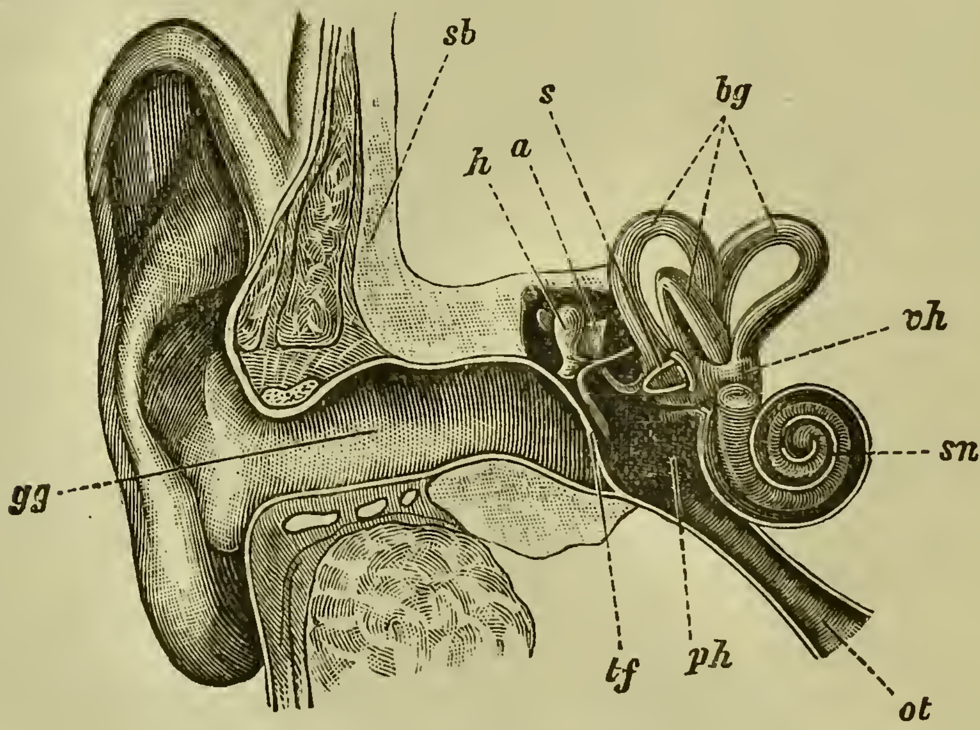

Fig. 13. Section of the Ear.
gg. Outer Auditory Canal. *tf*. Tympanum. *ph*. Tympanic Cavity *ot*. Eustachian Tube. *h*. Malleus. *a*. Incus. *s*. Stapes. *bg*. Semicircular Canals. *vh*. Vestibule. *sn*. Cochlea. *sb*. Temporal Bone.

§ **28. Sense of Hearing—the Ears**.—The organs of the sense of hearing are the two ears (Fig. 13). By their intervention sound-vibrations become perceptible. Each ear may be divided into a sound-receiver or external

ear: a sound-conductor or middle ear, and a sound-perceiver or inner ear.

The external ear consists of the shell of the ear formed of cartilage, and of the outer auditory canal leading into the cranium. The wax of the ear is secreted by fine glands opening on the surface of this canal. On the boundary between the outer auditory canal and the middle ear is stretched a soft elastic membrane, the *tympanum*. The middle ear consists of the tympanic cavity, the Eustachian tube and the auditory bones. The tympanic cavity is a small compartment filled with air and communicating by a fine tube covered with mucous membrane (the Eustachian tube), with the nasal part of the pharynx. The auditory bones which, according to their shape, are called *malleus* (hammer), *incus* (anvil), and *stapes* (stirrup), are joined together by elastic ligaments. The inner ear or labyrinth is composed of the *vestibule*, the *semi-circular canals*, and the *cochlea*, and is a cavity filled with fluid. The end of the auditory nerve, which runs through a passage in the cranial bone from the brain to the ear, distributes itself in the cochlea into numerous very small filaments lying close together like the keys of a piano.

The sound waves are received by the shell of the ear and outer auditory canal, and conveyed thence to the tympanum, which they make vibrate. The vibrations are transmitted onward by means of the auditory bones, and set the fluid of the internal ear in motion, whereby the nerve filaments are stimulated, and the sound-sensations conducted to the brain.

The tympanum is endangered by immoderately loud sounds, since owing to its tender quality it can be burst by violent sound-vibrations. However, this danger is obviated in this way: the sound-waves, in consequence of the connection maintained through the Eustachian

tubes between the tympanic cavity and the nasal and oral orifices, reach the tympanum not only from the external ear but also from the middle ear, and thus mutually weaken one another. To facilitate this counter-action between the sound-waves it is advisable to open the mouth during very loud noises (cannon-shots, explosions, &c.), in order to allow the air as wide a passage as possible to the Eustachian tube.

§ **29. Taste, Smell, Touch.**—The sensations of taste are produced by substances that are soluble in the saliva. They are communicated to the brain by means of the gustatory nerve, whose end-fibrils are contained in the small papillæ visible on the surface of the tongue.

The sensations of smell are received by the two olfactory nerves, which run from the brain to the sides of the nasal cavity and distribute their terminal fibrils in the mucous membrane of the nose. Only volatile substances which are conveyed by the atmosphere to the moist mucous membrane of the nose are capable of being perceived by smell.

The sensations of touch are obtained through the sensory nerves that terminate in the under-skin. A stimulation of the ends of the sensory nerves sometimes produces pain, sometimes a feeling of heat or cold ; we can also by means of these nerves perceive every contact of the skin, and estimate every pressure according to its strength. Hence we speak of sensations of pain, of temperature, of contact, and of pressure. We estimate the weight of a body on the one hand by the effort which the muscles make in raising it, and on the other by the pressure which it causes.

§ **30. Sleep.**—The brain, constantly working under the stimulation of sense-impressions, occasionally requires rest and recuperation : we obtain these by sleep. In sleep, breathing, blood-circulation, and digestion, pursue their

course uninterruptedly, while consciousness disappears, and the muscles cease their activity. At the same time the ultimate products of the process of food-assimilation resulting from the labour of the waking body, and which cause the feeling of weariness, are removed from the organs by the circulating blood, and lymph, and dispersed, partly through, the breathing, partly through the agency of the kidneys and sweat-glands.

In healthy, sound sleep, the respirations are less frequent and deeper than in the waking state. The duration of sleep is regulated by age. The babe sleeps upwards of twenty hours daily ; the growing child takes an ever-decreasing length of time for sleep, requiring in his seventh year about a ten-hours' sleep. From six to eight hours' sleep suffice for the adult. Generally the need of sleep is controlled by the labour which the individual has to perform ; still, strong men require a shorter time for rest than weakly persons. Frequently old people can sleep only a short time, and try to make good this loss by staying longer in bed.

B.—The Necessaries of Life for the Individual Man.

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§ **32.—The necessaries of Man's life in general.**—The conditions for the preservation of the life of the individual man are not completely fulfilled by the perfect structure and healthy character of his body. The activity of his organs, without which life is impossible, demands the supply of certain necessaries which can be obtained only from the surrounding world. Thus man requires air for breathing, water for cleansing and drinking purposes, food, and the means of procuring it to maintain the process of assimilation, and clothing, and housing to protect his individual warmth against the changes of the weather; light is also an indispensable requirement, and lastly, intellectual stimulation, which can be the less dispensed with, the higher the stage of development to which man has raised himself by education and civilisation.

The knowledge of the proper method of satisfying these wants forms the chief aim of hygienic science.

I.—The Air.

§ **33. The Atmosphere and its composition.**—The air required by men and animals surrounds the globe as the atmosphere in a layer about 70 to 80 miles high. It consists of a mixture of several gases; one hundred gallons of air contain about 78 gallons of nitrogen, 21 gallons of oxygen, $\frac{1}{25}$ of a gallon of carbonic acid, and a variable quantity of water.

§ **34. Nitrogen, Oxygen, and Carbonic Acid of the Air.**—The Nitrogen which forms the

chief mass of the air is called in German 'Choke-gas,' from the fact that it cannot support life by itself; a man placed in a space filled only with nitrogen must die. Nitrogen exercises no influence on the functions of the body.

Oxygen is indispensable not only for human and animal life, but also for the processes of combustion, and dissolution of all substances belonging to the animal and vegetable kingdoms (decomposition). Its action, which takes place only under certain conditions, and is called 'oxidation,' is of a purely chemical nature; it breaks up the organic substances, and combines with the carbon and hydrogen contained in them, to form carbonic acid and water. In spite of the never-ceasing large consumption of oxygen, its proportion in the composition of the atmosphere remains almost unchanged, since the quantity consumed is replaced by plants. For there is a constant exchange going on between animal and plant life; the carbonic acid exhaled by men and animals is decomposed again into its elements by the plants, and produces on the one hand the carbon necessary for the structure of the body of the plant, on the other the oxygen required for the air breathed by men and animals. Moreover, the plants also replace the consumed oxygen of the air, by decomposition of the water absorbed by their roots and leaves, since the hydrogen of the water enters into chemical combinations with the carbon of the carbonic acid.

Under the influence of electrical discharges in thunderstorms, a portion of the oxygen contained in the air condenses itself to two-thirds of the space originally filled by it. In this way is produced a special form of oxygen, called *ozone*, its presence in large quantities in the atmosphere may be perceived by means of its peculiar smell, and it possesses the power of oxidation in a still higher degree than the ordinary oxygen. The importance of ozone for the body and health was formerly rated very

high; at present only a purifying effect on the air, and thus merely a mediate benefit to man, are ascribed to its agency.

Carbonic acid passes constantly into the atmosphere in large quantities in all processes of combustion as well as in the breathing of men and animals. The air exhaled by an adult man during an hour contains from 22 to 23 litres of it. Besides carbonic acid is produced in the numberless processes of putrefaction going on upon the earth's surface, and it flows into the air from mines, earth-fissures and volcanoes.

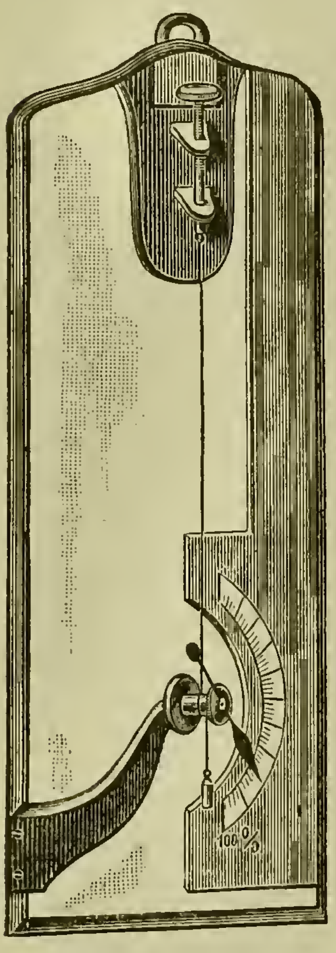


Fig. 14.
Hygrometer.

Carbonic acid is a poison for men and animals. Of course the small quantity of the gas which is present in ordinary air is inhaled mixed with oxygen and nitrogen without any injury, but injurious results manifest themselves as soon as the carbonic acid in the air increases, *e.g.* in carbonated wells or brewery vats. The inhalation of air containing from 1 to 5 per cent. of carbonic acid causes illness, dizziness, head-ache, and nausea; in air containing 30 per cent. of carbonic acid men die after a short time.

§ **35. Moisture and Heat of the Air.**—The degree of moisture of the air, *i.e.*, the amount of water mixed invisibly with the atmosphere by evaporation, is of great importance for our well-being. Dry air withdraws water and heat from the body, whereby the skin becomes chapped and cracked, the mucous membrane of the throat dry, and the voice hoarse, while a feeling of thirst arises. In moist air the water given off from the surface of the body

cannot evaporate sufficiently, the cooling of the skin is decreased, and an oppressive sensation arises ; we feel a slight increase in the temperature of such air heavy and close. The amount of water in the atmosphere is subject to considerable variations. It is measured by the *hygrometer* (Fig. 14). The simplest forms of this instrument depend upon the fact observed, that a humam hair becomes longer in moist air, and shortens again in dry air, or that woody fibre becomes bent in dry air and straightens again in moist air.

In places where facilities for large evaporation exist, as on the sea shore, on lakes, rivers, and other watery expanses, over meadows and woods, the air is usually moister than over sandy places, dry steppes and desert districts. However, there is a limit above which the air cannot absorb water. This is called the saturation-point, and it is indicated by numbers showing how many grammes of water in the form of vapour a cubic metre of air can hold. The height of the saturation point depends on the heat which the air receives, partly direct from the sun, partly from the surface of the earth and the living beings on it. The saturation point is thus stated by Flugge :—

Temperature	of the air	— 20°C	Saturation	point	1·06
„	„	— 10°C	„	„	2·30
„	„	± 0°C	„	„	4·87
„	„	+ 10°C	„	„	9·37
„	„	+ 20°C	„	„	17·06
„	„	+ 30°C	„	„	30·14

In consequence of these mutual relations between the saturation point of the atmosphere and its heat, warm air is as a rule moister than cold air.

The heat of the air is measured by the *thermometer.* This is a fine glass tube filled with alcohol or mercury ; its lower end widens into a spherical reservoir, and its upper end is hermetically closed. It indicates changes of temperature

by the rise and fall of the fluid since alcohol and mercury are in an especially visible manner expanded by heating and contracted by cooling. To maintain uniformity in the degrees of heat, the thermometer is provided with a graduated scale, for the limits of which the freezing point and boiling point have been chosen—that is, those points to which the alcohol or mercury rises when the thermometer is placed in melting snow and in the vapour of boiling water. The portion of the glass tube lying between these two points is divided in the *Centigrade* thermometer into 100 equal parts; in the *Reaumur* thermometer into 80 equal parts, and in the *Fahrenheit* thermometer (used mostly in England) into 180 equal parts or degrees. Thus an increase in temperature of 10 degrees Centigrade is equivalent to an increase of 8 degrees Reaumur or 18 degrees Fahrenheit. By means of a similar continuation of the gradation beyond the freezing and boiling points the indication of still higher or lower degrees of temperature becomes possible. In the Centigrade and Reaumur thermometers the freezing point is marked zero (0) the degrees above it as degrees of heat (+) those below it as degrees of cold (—). The freezing point on the Fahrenheit scale is marked 32 degrees, and the boiling point 212 degrees. In indicating a certain temperature the symbol ° is employed instead of the word "degree," and the initial letter of the thermometer used is added; thus, +11°C indicates eleven degrees of heat Centigrade, −14°R marks 14 degrees cold Reaumur. The following table shows the corresponding degrees on the three scales:—

C.	R.	F.	C.	R.	F.	C.	R.	F.
−17·8° =	−14·2° =	0°	+20° =	16° =	68°	70° =	56° =	158°
−10° =	− 8° =	+14°	+30° =	24° =	86°	80° =	64° =	176°
0° =	0° =	+32°	+40° =	32° =	104°	90° =	72° =	194°
+10° =	+ 8° =	+50°	+50° =	40° =	122°	100° =	80° =	212°
			+60° =	48° =	140°			

§ **36. Movement of the Air—Deposits.**—By an increase in heat the air, as a rule, becomes not only richer in aqueous vapour, but also expanded to a larger volume and thus rarified. Consequently warm air is lighter than cold air—that is, a cubic metre of rarified warm air weighs less than a cubic metre of dense cold air. Hence warm air exhibits a tendency to ascend, while cold air sinks downwards. Now, as the layers of the atmosphere nearest to the warm surface of the earth are especially heated, and as these layers are not of the same temperature in different parts of the globe, an interchange is constantly taking place between the hot and cold layers of air; this process is the chief cause of changes in the weather. On the one hand, the currents of air caused by this interchange become in certain conditions so strong, that we feel them as wind; on the other hand, the originally warm air as soon as it cools, becomes incapable of retaining all its water as aqueous vapour. A part of the latter separates itself as minute watery particles and becomes visible to our eyes as fogs and clouds. If the cooling becomes still greater, the atmospheric deposits of rain, snow, and hail occur. As the heating of the atmosphere is greatest at the equator, and the cooling greatest at the poles, the above-mentioned meteorological phenomena are especially produced by the influence of two opposed currents of air, of which one conveys the warm air from the equator to the poles (the equatorial current), the other impels the cold polar air towards the equator (polar current). Both currents suffer many changes in their direction in consequence of the earth's rotation.

The human body feels a movement of the air, only if the air-current travels at the rate of 1½ feet per second. The average velocity of the air-currents (strength of the wind) is calculated at 9½ feet per second. If the layer of air in con-

tact with the body changes so quickly, in consequence of the rapid motion of the air, that the diffusion of heat and moisture from the body is notably increased, we experience a feeling of cold.

§ **37. The Pressure of the Air.**—The pressure of the atmosphere is closely connected with its temperature and motion. The pressure of the air is the force exercised by the atmosphere by reason of its weight. As a rule, we do not feel the air pressing constantly on the surface of our bodies; we can convince ourselves of its presence, if, by ascending a high mountain we diminish it by the layers of air through which we have passed. As the air, on account of the decrease in the pressure from above is less dense in the higher strata of the atmosphere, we involuntarily increase the number of respirations in order to inhale sufficient oxygen. When a sufficient supply of oxygen is not attained, we feel tired, relaxed, and sleepy. Bleeding at the nose and mouth occurs through the bursting of small blood-vessels, whose sides are no longer supportod by an atmospheric pressure, corresponding to the pressure of the blood inside them. We miss the usual firmness in our joints, since the ends of the bones are not pressed against one another in the sockets with the customary weight, owing to the decreased atmospheric pressure. Such inconveniences which the dweller in the valley frequently experiences on high mountains, are grouped together under the name of "mountain-sickness."

The pressure of the atmosphere is subject to frequent changes; on a rise in the temperature and moisture of the air, it diminishes in proportion to the decrease in its weight thereby caused, and increases proportionately to the dryness and coldness of the air. The atmospheric pressure is measured by means of the barometer (Fig. 15). The most usual form of this instrument is the *quicksilver baro-*

meter, which consists of a glass tube bent in the form of a U. In one arm of the tube, which is closed at the top and emptied of air, is a column of mercury which is held in equilibrium by the weight of the atmosphere pressing on the open end of the other arm ; thus the column of mercury stands higher or lower in proportion to the greater or less pressure of the atmosphere. At the sea-level the average atmospheric pressure can support a column of mercury, 760 m.m. high. On more elevated points of the earth's surface where a lesser atmospheric pressure prevails, the barometer stands lower.

Another form of this instrument, the *Aneroid barometer*, is based on the fact that a thin metal box, which is exhausted, as far as possible of air, becomes compressed by an increase in the pressure of the atmosphere, and expands under a diminished pressure. The motions thus caused in the side of the box are transmitted by a special contrivance to a pointer, and by the latter are made visible and measurable on a surface provided with a graduated scale.

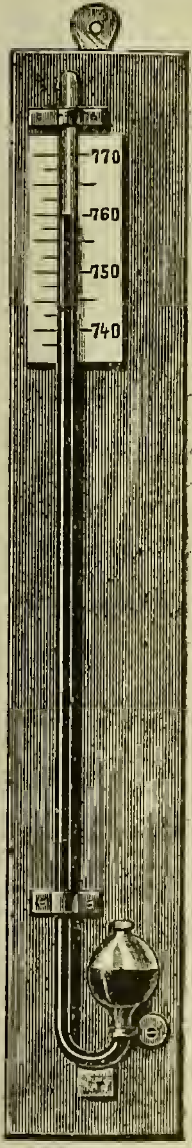


Fig. 15.
Barometer.

The variations in the atmospheric pressure are closely related to changes in the weather. In sultry weather the pressure is usually low, and also, as a rule, before storms ; winds increase or diminish the pressure according as they bring dry and cold, or moist and warm air.

§ **38. Impurities of the Air.**—Air usually contains a larger or smaller quantity of impurities. Among them are the effluviæ of human beings which are especially noticeable in sleeping rooms, or densely inhabited dwellings; in addition the gases produced in many

manufacturing industries (*e.g.*, glue-making, tanneries, gas works or chemical works), which cause unpleasant smells. Considerable numbers of small bodies can be perceived in the air as motes in the sunbeams, as soon as a ray of sunlight is allowed to fall through a chink into a dark room. To these solid elements contained in the air, belong also the dust produced by the constant movements in human abodes, or by manufactures such as plaster-works and lime-kilns, and the soot vomited forth by furnace-chimneys, &c. Atmospheric impurites of this kind can, by their number or character, not only become inconvenient for our breathing-organs, but even injurious to health, especially as such dust may be a carrier of disease-germs, and may communicate directly to us contagious diseases. The moist surface of the air-passage acts as a protection against the intrusion of injurious dust-particles, as also the manifold windings of the nares, for this causes many dust-particles to remain adhering to the sides of the nasal cavity. It is, therefore, advisable in a dusty atmosphere to breathe through the nose, keeping the mouth closed. However, all dangers are not thereby obviated: it is observed that certain diseases of the respiratory organs occur with especial frequency in places where the air is contaminated by many impurites. In towns the air is generally impure owing to the large traffic and the great number of manufacturing industries: the air is purest and most beneficial to our health where little dust is raised, *e.g.*, in forests and on the sea-shore.

§ **39. Climate.**—Each place on the earth's surface is influenced by its peculiar meteorological conditions, which are also of importance for man's health. The sum of these meteorological conditions is called the climate of the place. This is decided, on the one hand, by the average temperature, on the other hand, atmospheric pressure and

moisture, direction of the wind and rainfall are taken into account. Further, the frequency of a cloudy sky is of importance, inasmuch as a cloudy sky interferes with the sun's rays, and prevents the diffusion of the earth's heat to the higher layers of the atmosphere.

In general the climate is determined by the geographical position of a place, since the mean temperature decreases from the equator to the poles. We distinguish a tropical from a temperate or polar climate. The elevation of a place, from the difference in the atmospheric pressure, gives a peculiarity to a high or mountain climate as distinct from a low-lying climate. A relatively small variation in temperature and a considerable moisture of the atmosphere, together with frequent rainfalls distinguishes the sea or coast climate from the land or continental climate. Finally, the climate of a place can be essentially different from that of the surrounding district, if large forests or mountain ranges afford a protection against the wind, in which the district has no share.

II.—Water.

§ **40. Importance of Water.**—Water, like air, is one of the indispensable necessaries of our life. We need it as drinking water, and also for the preparation of other beverages, in the preparation of many foods, for cleansing our body, our utensils, our dwellings, and public places, and for manifold industrial processes. It is an essential constituent of our bodily tissue. The loss of water experienced by the body through the secretions of the skin, the kidneys, and the digestive processes, and through the exhaled air, requires a regular substitution. We satisfy our need of water partly by our victuals, which almost

without exception, contain water, but for the most part by beverages, to the consumption of which a feeling of thirst impels us.

§ **41. Drinking - water — Its Necessary Properties.**—Nature directly gives us water as the simplest and cheapest beverage: still, every water is not fit for this purpose. In general we rightly regard as good for drinking, water which is clear, colourless, free from undissolved suspended substances, which does not possess a strange taste or smell, which is cool and tastes fresh owing to a certain admixture of carbonic acid, and finally, which shows a definite "hardness."

Water is called "hard" when it contains a large proportion of lime or magnesian salts: in opposition to this, water poor in such salts is called "soft"; "hard" water is more pleasant to taste than "soft," but it is not suitable for washing, since it is a bad solvent for soap and many dirt-containing substances. Also it cannot be used in cooking, since in such processes it deposits its salts on the cooking-vessels as so-called "fur," and it cannot extract the nutriment from many food-stuffs so well as "soft" water.

From a hygienic standpoint, the most important property demanded from drinking-water is that it shall not contain any impurities injurious to health. The properties of good drinking water mentioned above will in general be a guarantee of its purity: still, water which is unobjectionable as regards appearance, taste, or smell may be the carrier of substances injurious to health. Especially, almost every class of water contains a smaller or greater number of little living bodies, only visible with a microscope, which are called micro-organisms. Of course, these are for the most part harmless; still, experience has taught that the microbes of contagious diseases

can pass into water used for drinking, and by means of it give rise to the spread of epidemics. Hence, in order to obtain a reliable judgment on the fitness for use, and purity of water, the amount of matter held in solution, as well as the microbes and bacteria, and the species of the latter, must be determined by experts.

§ 42. The Source of Water—Water Deposits—Cisterns.—Generally, by a knowledge of the source of the water, we obtain a vantage-point for judging of its fitness for use for ordinary purposes. In regard to its source we distinguish between deposited, spring, subterranean, and surface water.

Deposited water reaches the ground mostly as rain, and is poor in saline matter, and therefore very "soft." As the falling rain, at the same time cleanses the air, the first water falling in a shower or snowfall contains numerous impurities from dust and microbes of all kinds, which usually cause it to putrefy rapidly, while later-falling water is much purer. Although rain-water, on account of its "soft" character, is not palatable, and, if taken in large quantity, may even cause digestive complaints, still dwellers in waterless regions are compelled to collect it in vessels or walled cavities (cisterns), and to use it as drinking-water; such cisterns, however, are very liable to contamination.

§ 43. Subterranean Water and Springs.—If the rain-water falls on pervious soil, such as gravel or sand, it soaks into it and leaves behind, in the upper layers of the soil, as in a filter, the undissolved impurities brought with it from the air or the earth's surface. Here the water at the same time takes up certain mineral constituents of the soil (*e.g.* lime), as well as carbonic acid, which is largely mixed with the subterranean air filling the pores of the ground. The water now containing free carbonic acid, is able to dissolve more earth-minerals consisting of

chalk or magnesia compounds, and gradually acquires a "hardness" corresponding to the mineral matter received. As soon as in the course of percolation, it arrives at an impervious layer of soil (rock, clay, or loam), it spreads out over this according to its slope, as "subterranean water." If the impervious layer is of an undulating form, it collects in its deepest places as subterranean pools or lakes. If it has percolated through the surface of a hill or mountain, it can, by flowing down the impenetrable layer, reach the lower edge of the declivity, and appear on the surface as a spring. If, in its course, it flows into a space bounded above and below by impervious strata, and the upper stratum is pierced from the earth's surface, its spouts forth from the orifice with great violence, sometimes in a large jet (Fig. 16).

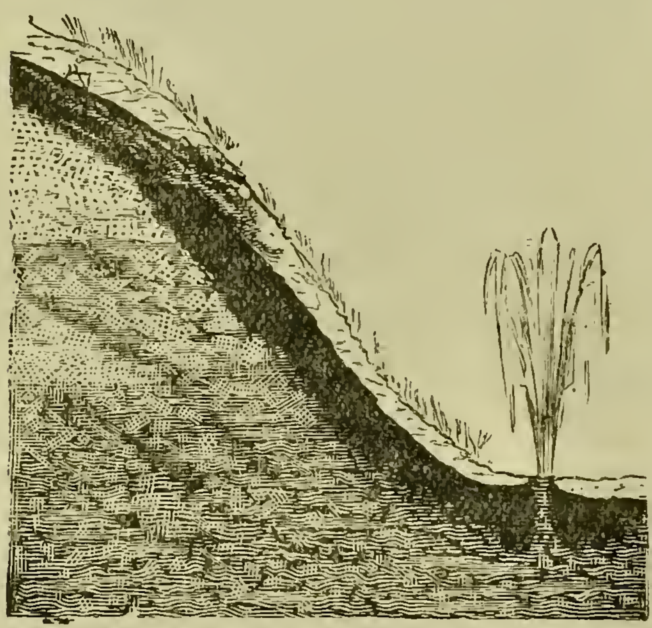


Fig. 16.
Subterranean Water under Pressure Spouts through the aperture bored in an Impenetrable Stratum.

Subterranean water as a rule is free from bacteria owing to the filtering action of the soil. But it often contains carbonic acid and mineral substances in large quantities, so that on account both of its refreshing flavour and its purity, it is well suited for drinking-water. Exception must be made of the water of "peat springs," which collects so close under the earth's surface that it is neither reliably filtered by the earth, nor sufficiently impregnated with carbonic acid and minerals, nor far enough removed from the influence of solar and atmospheric heat. The water of the sub-

terranean-wells flowing from a moderate depth rises slightly in temperature during the heat of summer, but is as a rule fit for use. The water of the mineral wells coming from a great depth remains uniformly cool, possesses a pleasant refreshing flavour, and is free from bacteria. The last-named water can only acquire unhealthy qualities by being polluted at the spot where it appears as a spring, or where it is drawn off through well-pipes for use.

§ **44. Directions as to Spring-water and Well-machinery.**—Impurities may pass into spring-water if the water is conducted into a collecting basin or well chamber in order to be drawn out of this for use, or to be distributed among human dwellings by the aid of pipes. In order to preserve their contents from such impurities, the collecting basin should be placed as far as possible from human habitations, and to ward off lateral influxes, impervious walls with an over-hanging edge, as well as a thick movable cover, should be provided. Water pipes should also have impervious sides, which should be thickened at the junctions of the pipes.

A distinction is made between surface wells and deep wells (Fig. 17). The water of the surface wells flows from the subterranean water of the uppermost strata of the earth, and hence easily contains unhealthy ingredients in populous districts, where the subsoil is polluted by the refuse of human habitations. The water of deep wells is usually free from bacteria, and the decomposed elements of organic matter. Still its utility—especially in North Germany—is more frequently destroyed than surface-water, by a mixture of iron salts, which imparts to the water an inky taste, and in the open air causes a gradual deposition of a brownish slime. Various devices for freeing deep wells from these iron salts

have been invented, and further improvements in this direction are anticipated.

As the result of the unsuitable construction of a well, its water frequently exhibits a bad quality ; bucket and pump wells especially often prove objectionable. These are formed by excavating the earth down to the water-bearing strata, and supporting the sides of the excavated hole by means of beams of timber or masonry. In the hollow or shaft thus constructed the sub-soil water collects on the floor or bottom, and is raised by means of draw-buckets (draw-wells) or pumping-machines (pump-wells). Through defects in the sides or unsuitable covering (which is sometimes entirely wanting), these are in a high degree exposed to pollution from the surface or the lateral strata. This happens in particular if these shaft wells, as is frequently the case in rural districts, are placed in the neighbourhood of badly protected dung pits and cess-pools, so that the contents of the latter find their way into the well-water (Fig. 18). On the other hand even very thick walls in a well, give no reliable guarantee for its continued purity, since the massive masonry required sometimes bursts or cracks, and the latter are usually first discovered when the pollution of the well is already an accomplished fact.

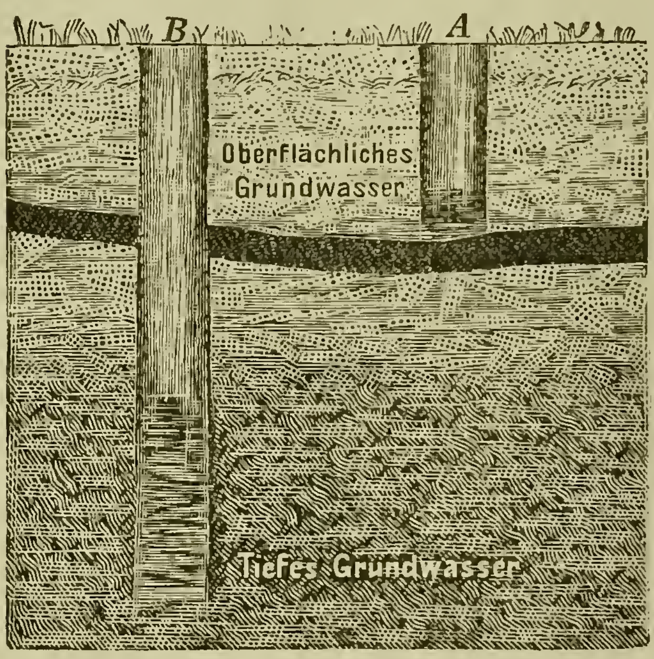


Fig. 17.

Surface and Deep Wells.

Artesian wells (Fig. 19) afford greater security against pollution. They consist of an iron pipe which is driven into the earth as far as the strata supporting the subterranean water, and is provided with a pumping arrangement at its upper end. The impenetrability of the metal sides excludes every lateral influx to the water.

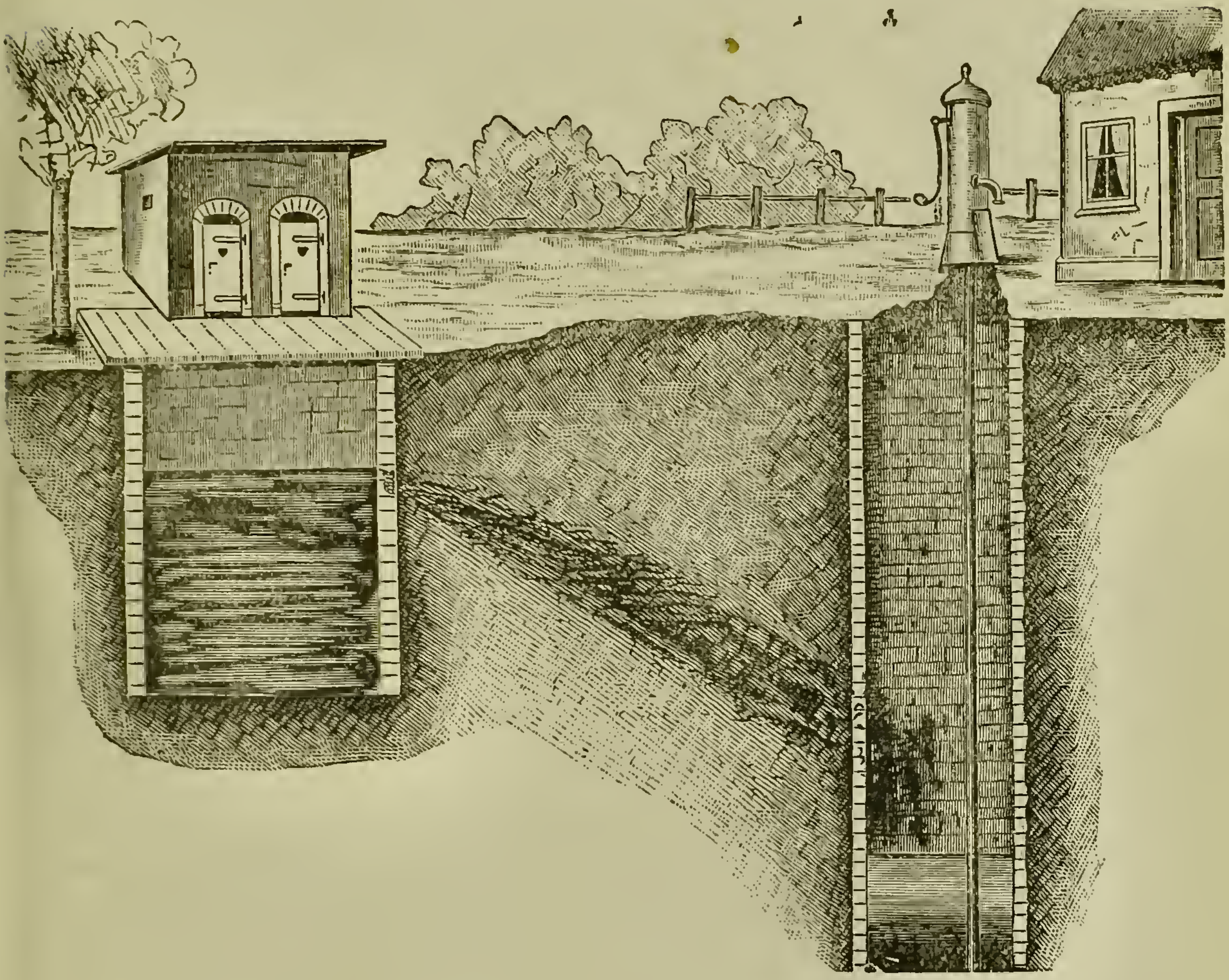


Fig. 18.
Pollution of a Draw-Well by the contents of a Neighbouring Cesspool.

§ **45**. In many places it is impossible or very difficult to open up the subterranean water, either because its basin lies too deep beneath the earth's surface, or because the subsoil consists of rock, and cannot be bored without great difficulty, or because the water itself is unfit for use, owing to the salts it holds in solution. If in such places springs are not available, the inhabitants are reduced to the

necessity of consuming surface water. By this term is meant the water of rivers, brooks, lakes, ponds, and generally all water found on the surface of the earth. Its use as drinking water is very much inferior to spring, or subterranean water; moreover, it does not possess a refreshing coolness in summer, as it is exposed to the influences of the atmosphere, and of the sun's rays; it is poor in carbonic acid and mineral substances, and, as a rule, contains impurities. The latter include among others, the excreta and debris of aquatic animals and plants, and especially the refuse of the organic world inhabiting the borders of the sheet of water. Frequently among the domestic refuse, the excretions of sick persons containing the germs of infectious diseases are carried to the water. Manifold dangers to health, especially epidemics of typhoid and cholera, are the result of the use of surface water. For instance, the devastating cholera epidemic which visited the city of Hamburg in 1892, was traced to the unfiltered drinking-water of the city which was taken from the River Elbe.

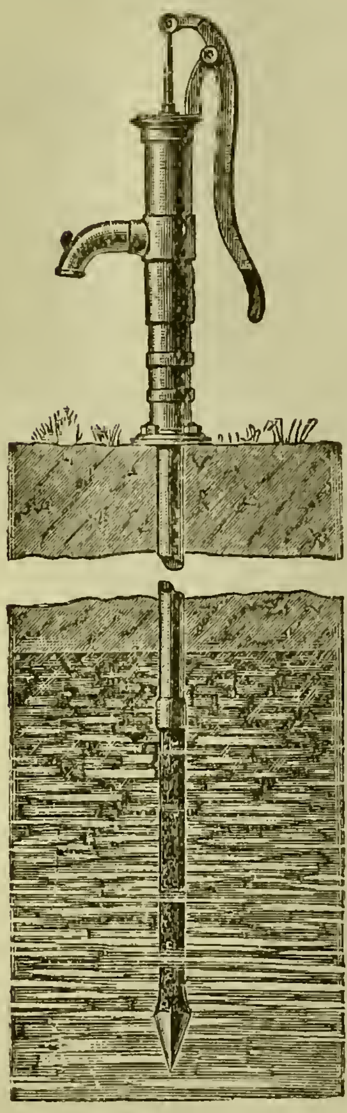


Fig. 19.
Fountains.

In many stagnant or sluggishly flowing bodies of water, such as ponds, ditches, canals or small streams, the resulting pollution shows itself in the muddy colour, the foul smell, and taste of the water; investigation has shown that in this state, water contains microbes in myriads, up to 100,000 per cubic centimetre. However, the influence of the pollutions is smaller, the greater the

body of water, and the quicker the water is carried along by the current. As some distance from such pollution the water is usually found pure again, it is assumed that it is able to rid itself of the impurities by means of a so-called self-purification. This process takes place on the one hand through the deposition of the filthy matter on the bottom and sides of the water-course, on the other by the breaking up of the noxious ingredients carried along by the current. Certain species of noxious bacteria are able, however, probably under certain conditions not yet sufficiently explained, to exist for a long time in water and transport diseases from place to place: in particular the spread of cholera observed in many epidemics of that disease has been found to be connected in the water-courses with a transportation of the cholera-germs through the water.

§ **46. Artificial Purification of the surface water: Water-filters.**—In view of the foregoing the employment of surface water for domestic purposes must be regarded as hazardous, although by certain processes the dangerous properties of the water can be more or less successfully removed.

The disease germs in the water are most certainly destroyed by thorough boiling: however, the water thus loses its carbonic acid, and with the latter also its refreshing taste. Most of the chemical means adopted for purifying water are less successful as regards disease germs, and the taste of the water is similarly injured by them.

Those processes which depend upon allowing the water to deposit its impurities by being kept for a long period in clarifying glasses, only remove the coarser impurities, and hence are insufficient; on the other hand, filters possess a much greater value. Small filters, the so-called house-filters (Fig. 20), in the construction of which charcoal, asbestos, and porous stones, burnt clay, porcelain or

silicious marl (Fig. 21), are employed, can clarify the water very well ; still they cannot free it with certainty, or at most only temporarily, from the germs it contains. For as an increase of microbes takes place in the sides of the filter, the germs contained in the filtered water are sometimes increased, and may even be finally greater than before filtration.

Fig. 20.

Composite House-filter.

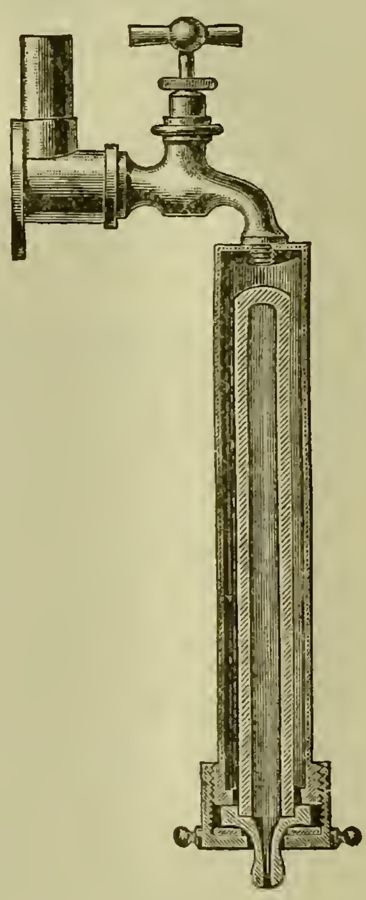


Fig. 21

Filter of Porcelain.

The Sand filters (Fig. 22) employed in many towns for purifying water are more successful. These sand filter-beds extend over large surfaces on which are laid, in layers, first gravel and fine sand, then gradually small stones, and lastly large stones. The water to be purified, filters from

above through all these layers, and then passes by channels into pure water reservoirs and thence into the pipes for supplying water. As a valuable filtering portion of the bed must first be deposited by the water itself in the form of a fine mud-coating on the surface, the first water coming from a newly-erected or cleaned filter bed is allowed to run waste. When properly arranged, and skilfully used, the sand filters retain the coarser impurities of the water completely, and also the bacteria to a large extent, but by improper construction or want of care in their use, the results of filtration are entirely lost. Hence

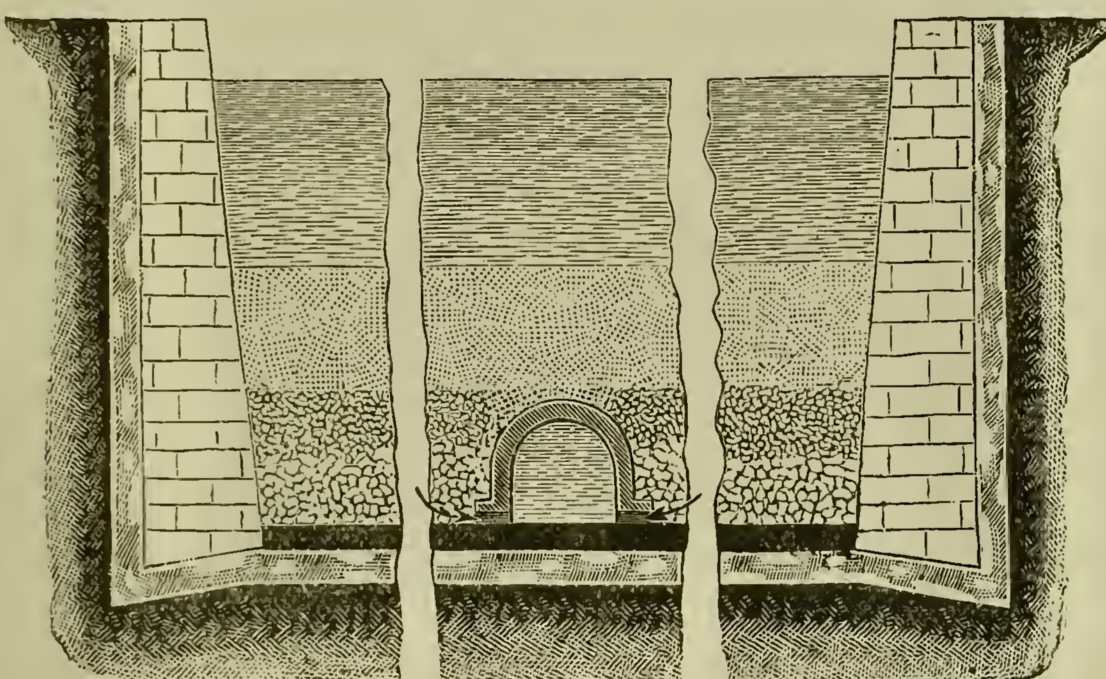


Fig. 22.

Plan of a large Sand filter for Purifying Surface Water.

in recent years strict government supervision has been required in the construction and use of sand filters intended for the filtration of surface-water. Many authorities desire, that wherever accessible, deep underground or deep well-water should be exclusively employed for drinking purposes to the entire disregard of surface water.

§ **47. Sea Water.**—The kind of surface water most widely spread over the earth is the water of the ocean or

sea-water. This is unfit for drinking on account of the high percentage of salt it contains. If however, it is necessary to use it as drinking water, it must be distilled that is, boiled, and the ascending steam conducted through a cool tube. The steam is thus again condensed into water, while the salts remain behind in the boiler. Such water, however, is only drunk in cases of necessity, and with some addition, for without such additions it has an insipid taste owing to its want of gaseous and mineral ingredients, and hence could not be tolerated for any length of time.

§ **48.**—The water of the deeper strata as already mentioned (§ 42) is rich in dissolved salts and in gases. It gains thereby, as a rule, in flavour, and the dissolved salts sometimes impart salubrious qualities to it. Well-water possessing such properties and rich in salts is called mineral water. As such water is beneficial, and generally esteemed by many healthy and sick people as a refreshing drink, many mineral waters, especially the well-known carbonated fluids (such as Seltzer and Apollinaris water), are artificially imitated to a very large extent by forcing carbonic acid into ordinary water under strong pressure. These preparations may prove injurious to health if bad water is employed in their manufacture.

§ **49. Use of Water in removing dirt.**—The importance of water for our health is not exhausted by its use as drinking-water: on the contrary, of the water consumed by us, which on an average varies from 50 to 150 litres per day for each individual according to his mode of life, only 3 or 4 litres is used for domestic purposes inclusive of the portion indispensably necessary for the preparation of food. The remainder subserves especially the purposes of cleanliness and is used for the removal of dirt.

All dirt elements which are found in our surroundings,

or adhere to our bodies, our linen, or clothing, can become dangerous to health. Since together with earthy matter, they constantly contain the refuse of the organic world, and debris of animals and plants, they usually pass very readily into a state of decomposition, and become offensive to us by their smell. Besides they also, sometimes, contain the pulverised elements of dried-up expectorations, and other excreta of sick persons, which may include disease germs. Such dirt easily pollutes our food. or when whirled about as dust, penetrates through the digestive or respiratory passages into the body (cf. § 192). The surface of our bodies also affords to these dirt elements a field for their injurious effects, for they penetrate through the pores into the small glands, or through small wounds, pass under the skin, mingle with the secretions of the skin-glands, and thus find their way into the interior of the body. In this way is explained the origin of many skin-diseases, which appear sometimes as skin-eruptions or small superficial sores. Sometimes, specially dangerous germs adhere to the dirt-elements, and cause erysipelas and inflammation and festering of the tissues (cf. § 214-216).

Water offers us the best means of removing dirt. With it we sprinkle the streets, scour our dwelling-rooms, and cleanse our linen, numerous domestic utensils, and our own bodies. In such cases it is not a matter of indifference what class of water is employed. Since the cleansing consists not merely in a washing away of the dirt, but is aided also by the capacity of the water for dissolving other substances, the process succeeds best when soft water is used. For cleaning our person and our linen, rain-water, and failing it, surface-water is especially prized. However, it must not be forgotten that polluted surface-water, *e.g.*, water from sources which receives outflows from house or town drains, or which has been used in washing the linen used with sick

persons, may produce diseases in persons who imprudently come in contact with it. In cases where, through lack of soft water, recourse must be had to hard water for cleansing purposes, it is advisable to boil it before using it, because thereby, a part of the mineral substances causing the hardness, is separated, and the capacity of the water for dissolving dirt-elements is increased.

§ **50. Auxiliaries of Water for Cleansing —Care of the body, skin and hair.**—The process of cleansing with water is facilitated by the use of implements of many kinds (brooms, mops, sponges, scouring-cloths, &c.), or by additions, such as soda or sand, which loosen the dirt or make it more easily soluble. For removing fatty dirt-elements, most help is received from soap, a combination of fatty acids and alkalies, which is now an indispensable necessary among all civilised nations.

The cleanliness of the body promotes health. For infants and invalids who soil themselves with their own excretions, it is particularly essential, but even in the case of other people it removes many dangerous disease substances, keeps vermin from the body, strengthens the skin (cf. §§ 6 and 23), and imparts to it a pleasant appearance.

For cleansing the body, the application of soap and water, is, as a rule, sufficient; they may be helped sometimes by sponges and brushes. In washing tender skin, not too cold water and not pungent soap are recommended The sweet-smelling substances frequently mixed in soap, are either not injurious or indifferent as regards health.

The regular cleansing of the hair is also important, as it removes the easily decomposable secretions of the skin-glands, which are injurious to the growth of the hair, and also the scurf constantly separating from the upper skin. Hence, dry hair is with advantage kept soft by mild

pomade or hair oil, and prevented from breaking off or falling out. All other waters, tinctures, essences, powders, cosmetics and disinfectants recommended for the care of the skin and hair (*e.g.*, tar or thyme soap) should only be used under medical directions, since preparations of this kind offered for sale, sometimes contain injurious substances (for instance, poisonous metallic compounds or colouring stuffs), and moreover, are not beneficial to every one. More especially is this true of mixtures for colouring the skin and hair, which frequently have a very injurious effect owing to an admixture of lead.

§ **51. Baths and Water Cures.**—Besides thorough washing, baths offer the most perfect means of cleansing the body, and they possess the further advantage of acting in a refreshing, strengthening, and sometimes healing manner. Cold baths, especially swimming, in trustworthy river or lake water, and in the sea, stimulate the body and mind, and promote strength; warm baths must take the place of cold baths in the case of children, invalids, and also old people, and have in addition a soothing effect, and promote perspiration. Baths in hot and cold mineral water are employed for healing purposes. It is advisable not to plunge into cold water until one has become cool, and to dry and dress quickly, when the bath is over, and also to avoid chills. The use of impure water for bathing purposes is similarly dangerous as its use for drinking.

The healing effects due to water are not limited to baths. In the form of poultices, lotions, and douches, it can also act beneficially, and thereby contribute to the restoration of health.

III.—Food.

§ **52. Necessity of Food.**—Food supplies the body with the materials which it requires for its growth, and for replacing the tissue used up by the cellular activity. We are induced to take food by the feeling of hunger. The need of food is in proportion to the purpose which the food has to fulfil, different in quantity and quality; as a rule it is increased by an increase in the consumption of materials in the body. Hence, during vigorous muscular activity a more considerable supply of food is required than during repose, and in winter we involuntarily augment our food-supply because the cold of the surrounding air forces our body to develop more heat, and this must be done by an increased supply of materials to the cells of the body (cf. § 181).

Growing men, on account of the requisite new formation of bodily tissue, require a somewhat more composite class of food than is necessary for the sustenance of the grown man. For strengthening the body during convalescence after exhausting illness, those classes of nourishment which can be most easily acted on by the digestive organs are most suitable.

§ **53. Composition of Food.**—In accordance with its purpose, our food must be composed of all those fundamental chemical substances which have a part in the formation of our body. Among them nitrogen is specially important, for as an essential constituent of the so-called albuminous bodies, it assumes an important rôle in the chemical structure of the body. Next we require carbon, hydrogen, and oxygen. These three primary substances, are the chief constituents of a series of non-nitrogenous bodies which, on the one hand, supply in great part the

material used up in the cellular functions producing heat, and, on the other, as fat, form likewise a store-house of nutriment in the body. This supply affords material for the cellular functions at times when the reception of food in the body is impaired, as by sickness: in this way it protects the albuminous bodies in the tissues from wearing out, and so preserves the organism from a too sudden collapse. Hydrogen and oxygen, moreover, in their union as water, take an important share in the composition of the body, of which 59 per cent. in weight consists of water. The other elements entering into the structure of the body are chlorine, sulphur, phosphorus, calcium, and various other light metals, and, lastly, iron. The chlorine, in combination with sodium (as table-salt), forms an important constituent of the blood, and in combination with hydrogen (as hydrochloric acid) an active element in the gastric juice. Sulphur is to be found in all albuminous bodies: phosphorus and calcium form the great mass of the bones: iron is contained in the red corpuscles of the blood.

§ **54. Food and Nutritive Substances.**— The above-mentioned elements are not received in their pure state into the body in the process of digestion: on the contrary, the food we consume is composed of a series of nutritive substances, and the latter are formed of the above elements. Besides water and some salts, nutritive substances are divided, according to their chemical constitution, into a nitrogenous group—the albuminous bodies; and two non-nitrogenous groups, the carbo-hydrates and the fats (cf. § 21).

The albuminous bodies have received their name from the white of an egg, which is merely a saturated solution of one of these bodies, albumen, and which is known by coagulating on the application of heat. Moreover, albumi-

nous bodies form the essential nutriment of meat, are found as caseine in milk, and are separated from the latter by coagulation when it turns sour. Of food stuffs belonging to the vegetable kingdom, pulse in particular contains albuminous bodies in the form of legumen, and the albumen of corn or gluten, is an important constituent of bread.

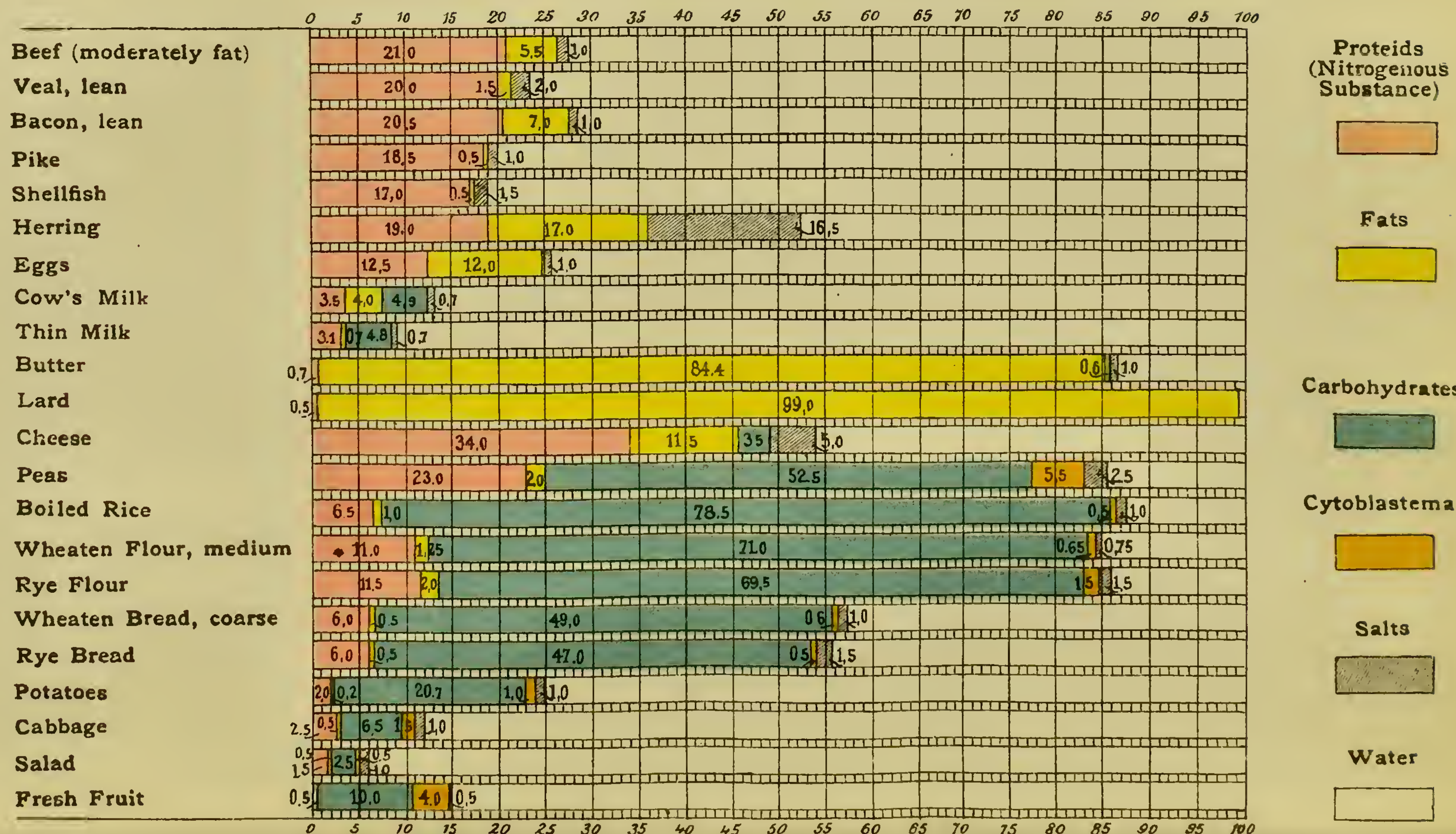
The carbo-hydrates are composed of carbon and the two elements of water (oxygen and hydrogen), and are pre-eminently contained in the food stuffs of the vegetable kingdom. We consume them largely in the shape of starch, which forms the essential nutriment of potatoes, and all farinaceous fruits. Other carbo-hydrates are the various species of sugar and cellulose (or woody fibre). The former are found chiefly in vegetable food-stuffs (as grape-sugar, cane or beet-sugar, fruit-sugar), and also in milk as milk-sugar. Some tissues of the human or animal body (for instance, the muscular tissue and the glandular tissue of the liver) contain substances resembling sugar. The cellulose constitutes the chief element of vegetable cells, and imparts its firmness to wood: it is almost insoluble in the human gastric juices, and hence is not of any importance for our nourishment.

The fats are contained both in the animal and vegetable kingdoms: they include lard, butter, and oil.

We consume water not only in its purity (cf. § 41) and as a solvent of various substances in the shape of beverages, but also as a constituent of solid food, since it enters into the composition of most food stuffs in a greater or less degree. Young vegetables and fruits sometimes consist of upwards of 99 per cent. of their weight of water.

The salts which convey chlorine, phosphorus, a part of the sulphur, and the metals, necessary for its structure to the body, are found in many food stuffs. We use chloride of sodium or common salt as a seasoning for most viands.

The Nutritive Value of some Foods (after König)



Among food stuffs, the albuminous bodies are the most important, because they supply the nitrogen necessary for the formation of tissue. The non-nitrogenous food stuffs supply especially the material consumed in the cells, and moreover, if partaken in excess, lead to an increase in the fat of the body.

§ **55. Choice of Food.**—The qualities of the nutritive substances contained in food are, in general, unimportant as regards the feeling of satiety arising from them, because the latter depends essentially on the state of fulness of the stomach. Still the composition of our food is by no means a matter of indifference to our well-being; if our body is not to waste, we must supply it regularly with special nutritive substances, in definite proportions, and sufficient quantities.

In ordinary circumstances, that food to which we have accustomed ourselves, under the guidance of natural impulse, corresponds best to the demands of the body. When it is necessary to determine the daily food supply for a large number of men, where the choice of the individual cannot be consulted (*e.g.*, in the maintenance of colleges, barracks, prisons, and similar places), the calculation is based on the quantity of nitrogen and carbon which the body gives off on an average in the course of a day through the lungs and skin, as well as with the excreta and urine. A suitable diet must at least contribute to the body such quantity of these elements as will suffice to replace these daily losses.

By careful investigation it has been ascertained that an adult well-nourished man in our climate loses every day, on an average, when working moderately, 18·8 grammes of nitrogen and 281·2 grammes of carbon in the manner indicated. By supplying about 120 grammes of dry albumen, the stated quantity of nitrogen, and perhaps 64 grammes of

carbon, would be restored to the body. To replace the missing 217 grammes of carbon, about 280 grammes of fat, or 475 grammes of carbo-hydrates, would be required.

In diet calculations, however, it must be remembered, that the individual nutritive elements are turned to account differently by the body according to their origin. We receive albumen from food stuffs derived from the animal kingdom (flesh, eggs, milk), in a much more easily digestible form than from food stuffs produced by the vegetable kingdom (pulse and meal); hence, if we wish to satisfy our want of nitrogen solely by vegetable food, we must consume larger quantities of such food. On the other hand, our supply of carbon can be just as easily obtained from vegetable food stuffs as from animal fat. A diet composed only of vegetable food (vegetarian diet) can satisfy the demands of the body for nutritive substances only on the condition that very large quantities of food are consumed. But a one-sided diet of this kind leads to the result, that the digestive organs, in consequence of the increased quantity of food, must increase their exertions at the cost of the physical development of the entire body. It is advisable, therefore, that a part of the necessary nitrogen (frcm experiment, at least a third part) should be supplied to the body from the animal kingdom. In the selection of diet, the cost of the various food stuffs must be taken into account; that of animal food is generally highest.

§ **56. Calculation of daily diet.**—The facts and considerations just mentioned form the general principles by whose aid the food-supply for large communities of men is usually estimated. In individual cases naturally, the age, the sex, the condition of nourishment, and the occupation of the person in question are taken into account. Furthermore the season of the year, and

the climate, cannot be left out of consideration in laying down a dietary, as, for instance, in winter and in cold districts, large quantities of fat must be consumed in order that the heat-producing material of the body may correspond to the increased diffusion of heat.

The minimum standard for daily diet has been approximately calculated as follows :—

		Albumen	Fat	Carbo-Hydrates.
		grammes.	grammes.	grammes.
Children up to $1\frac{1}{2}$ years of age	requires	20—36	30—45	60—90
,, from 6 to 15 years	requires	70—80	37—50	250—400
Male adult at moderate labour	requires	118*	56	500
Female ,, ,,	requires	92	44	400
Male adult at severe labour	requires	120—145	100	500
,, person of advanced age	requires	100	68	350
Female ,, ,,	requires	80	20	260

§ **57. Preparation of food—Spices and Condiments.**—If the diet measured as above is to become a really healthy and strengthening nutriment, care must be taken on the one hand to provide for a change of diet, and on the other to have the food properly prepared. A uniform diet easily produces loss of appetite and disgust. Only by cooking do many victuals become edible, for our digestive organs can assimilate many classes of food only in a boiled, roasted, or baked form, and not a few viands only by the addition of stimulating spices.

By boiling vegetable foods, the contents of the vegetable cells are freed from the husk, and changed into a form more easily accessible to the agencies of our digestive organs ; in particular the starch is transformed into a more

* Of this 105 to 106 grammes must be supplied in a form easily digestible by the body.

easily digestible paste. In meat also the edible elements are opened up by boiling, since the indigestible fibres connecting the bundles of muscles are thereby loosened; and partly changed into soluble gelatine, while the albumen coagulates. At the same time the parasites sometimes present in meat, such as "trichinæ spiralis" and disease-germs, which enter the meat either from the atmosphere, or through lack of cleanliness in slaughtering, or in the course of preserving, or selling, are destroyed or rendered harmless by boiling. The latter result is less certainly attained by roasting, for in this process the high temperature acts especially on the surface, while the inner parts, on account of the bad conductivity of meat, remain more or less raw. However, roasting increases the pleasant taste of the meat, as under the influence of the heat of the oven, substances pleasant in taste and smell are produced in the superficial layers of meat, owing to chemical action.

The seasonings (salt) and spices (pepper, ginger, allspice, &c.) have for our food an importance similar to the so-called "aids to digestion" (tea, coffee, chocolate, alcoholic beverages). Supplied to the body in moderate quantity, and with judicious selection, they increase the capacity for digestion while they are also pleasing to the taste: partaken of immoderately they cause delay in digestion, and the functions of other organs.

The time of the day at which we partake of food is not unimportant. Custom and habit have prescribed three principal meals in the day—breakfast, dinner, and supper. During vigorous bodily or mental exertion it is advisable to take a not too scanty breakfast shortly after getting up, and to take a plentiful dinner at an hour corresponding to the middle of our working day—say, from half an hour to two hours after midday. On the

other hand supper should consist of far less food than at either of the two other meals, and should be eaten at least an hour and a half before bedtime, so that the work of the digestive organs, as well as of the other organs of the body, may be moderated and rest granted to them. It is advisable to rest a short time from work after each meal, so that the activity of the digestive organs required for assimilating the food, may not be interfered with by other bodily or mental functions.

§ 58. **Manner of taking Food—Care of the Mouth and Teeth.**—The manner in which we partake of food and drink is also of great importance for health. Too hot viands and beverages attack the mucous membrane of the mouth, larynx, and alimentary canal, and produce disorders in the stomach. After partaking of very cold drinks, nausea, vomiting, pain in the stomach and violent internal pains are observed. It is of great importance that the food should not be hastily swallowed down, but it should be adequately prepared for digestion by thorough chewing and mixing with the saliva. Persons who cannot do this through lack of good teeth, suffer from numerous stomach disorders. Great attention should, therefore, be paid to the care of the mouth necessary for the preservation of the teeth.

For want of proper cleaning, scraps of food collect between the teeth and in hollow teeth, and there decompose, giving rise to the pains in the teeth and gums and injuring the good quality of the food by the admixture of their decomposed debris. Care of the teeth aims at preserving for the crown of the tooth, its protecting enamel and for the neck and root of the tooth its covering of the gums. In the first place attention must be paid to the removal of the tartar which gathers on the teeth between the neck of the tooth and the gum, uncovers the former and retains morsels of food in its

uneven surface. We should regularly and frequently rinse and gargle with moderately cold water. As an addition to water so used, some drops of tincture of myrrh, eau de Cologne, or alcoholic solution of oil of peppermint may be useful. We should brush the teeth with a tooth-powder which will not injure the enamel. For such purposes preparations having white chalk or carbonate of magnesia as their basis may be recommended: they may also be perfumed and coloured in various ways. Powdered charcoal yields just as good a tooth-powder, but beware of tooth preparations which injure the enamel, and thereby induce diseases of the teeth. A further precaution, as regards the enamel, is to avoid exposing the teeth to a sudden change from cold to heat, and the mastication of very hard bodies; the teeth should also be protected from the action of powerful acids. We should accustom ourselves to chew indifferently on both sides of our mouth. Lastly, if possible it is desirable to get the teeth examined, perhaps twice a year, by a dentist, have them freed from tartar, and, if necessary, treated as may be required.

The Means of Nourishment.

§ **59. Selection of Nourishing Food in Drawing up a Dietary.**—The change of diet required for proper nourishment (§ 57) is rendered easier owing to the great number of nutritive sources available. Natural instinct generally guides us to a suitable selection. For instance, we satisfy our want of fat, sugar, and starch, when consuming albuminous nutriment, since we eat with the meat, fatty sauce, and boiled potatoes and fruit. Similarly we try to supplement a diet rich in starch, by adding to it buttered bread and cheese, *i.e*, the necessary comple-

ment of fat and albumen. The chemistry of food enables us in the most perfect manner to regulate the composition of our diet in accordance with the requirements of our body, since, that science indicates the quantitative proportions in which the individual nutritive elements are contained in different articles of diet.

The accompanying coloured diagram (26), shows at a glance the composition of some important sources of nourishment according to the data supplied by chemistry. The names of the different foods are given under one another: on the right of each is a horizontal coloured band. The red colour indicates the albumen contained in the food in question, the yellow shows the fat, the blue the carbo-hydrates, the brown the indigestible cellular element, the black shading the salt, and the final white space the water it contains. The length of the individual coloured bands, measured according to the number of divisions they occupy, gives the percentages of the various nutritive elements contained in the food in question. For instance, in the case of moderately fat beef the red colour denoting albumen, occupies twenty divisions because beef contains about twenty per cent. of albumen. In lean bacon the yellow band covers seven divisions (from 20 to 27), because in such meat seven per cent. of fat is found.

On the basis of the values given in the coloured table of the amount of nutritive elements contained in each food, the following diet might be drawn up for a day, which in spite of its simplicity and cheapness supplies the nutritive requirements of an adult man under moderate labour, according to the dietetic standard given in § 56.

1. For Breakfast—Milk, coffee, bread and butter, *i.e.*, 200 grammes thin milk, 250 grammes of rye-bread, and 25 grammes of lard.

2. For Dinner—Beef with pea-soup, potatoes and bread,

i.e., 150 grammes of moderately fat beef, 150 grammes of peas, 400 grammes of potatoes, 10 grammes of lard, and 100 grammes of rye-bread.

3. For Supper—Milk porridge, with rice and bread and cheese, *i.e.*, 300 grammes of thin milk, 40 grammes of rice, 20 grammes of cheese, and 250 grammes of rye-bread.

Accordingly, for the whole day would be used:—

Class of Food.	Weight in grammes.	Price in Pence.	Amount of		
			Albumen	Fat	Carbo-hydrates.
			grammes	grammes	grammes
Rye Bread -	600	$1\frac{1}{3}$	36	3	282
Thin Milk -	500	$\frac{3}{5}$	15·5	3·5	24
Potatoes - -	400	$\frac{1}{3}$	8	0·8	82·8
Beef (moderately fat)	150	$2\frac{7}{8}$	31·5	8·3	—
Peas - -	150	$\frac{3}{5}$	34·5	3	78·8
Rice - -	40	$\frac{1}{4}$	2·6	0·4	31·4
Lard -	35	$\frac{3}{4}$	0·2	34·7	—
Cheese - -	20	$\frac{1}{4}$	6·8	2·3	0·7
TOTAL -	1,895	7	135·1*	56·0	499·7

Thus for seven pence the constituents of a day's diet can be procured, that is 1,895 grammes of food-stuffs, contain 135·1 grammes of albumen, 56 grammes of fat and 499·7 grammes of carbo-hydrates, while the daily minimum standard diet laid down in § 56 for an adult male under moderate labour consists of 118 grammes of albumen, 56 grammes of fat and 500 grammes of carbo-hydrates. In the daily diet set out above about 2-5ths of the necessary albumen is derived from food-stuffs supplied by the animal kingdom. (Flesh-meat, milk and cheese), but experience shows that it is sufficient if 1-5th of the albumen required is supplied by these more costly viands. By the addition of sausages and butter, which may be introduced along with

* Of this about 115 grammes are used up by the body.

bread for breakfast and supper, the daily diet may be made still more nourishing and by adding some appetisers, *e.g*, coffee, beer, or wine, a greater variety is obtained.

In deciding on the value of individual food-stuffs it is not sufficient to know their nutritive value indicated by the amount of nutritive elements they contain ; besides, other properties of the various foods, important from a health point of view, must be taken into consideration. Thus the eating of many vegetables may lead to disorders in the functions of the stomach and intestines, white bread is more easily digested than black bread, and so on. It is, therefore, necessary to inquire as to the digestible character of individual food-stuffs.

§ **60. Corn and Flour.**—For the support of large masses of the people, the food stuffs prepared from corn are of paramount importance. The plants from which they are obtained, brought by commerce to the most diverse parts of the earth, generally flourish best in places where the climate and the properties of the soil afford favourable conditions for their thriving.

Most kinds of corn belong to the botanical family of grasses, and consist, like them of root, stalk, leaves and ear. The ear bears the flowers, and later on the fruits in the shape of grains of corn.

Each grain of corn consists of a shell formed of indigestible cellular substance and of the kernel, which contains the nutritive elements. By grinding, the latter are separated as far as possible from the indigestible cellular material, and in the form of flour, becomes available for the preparation of human food.

Starch and albumen are the chief nutritive elements in corn ; still sugar, fat and salt are not absent, so that corn yields nutritive elements of every kind. Among the albuminous substances gluten must be especially mentioned,

this produces the baking qualities of flour, since it imparts the consistency to dough, and thus renders possible the adhesion of the bread while "rising."

Flour is sometimes adulterated with ingredients of all kinds, of no value for human support, and in some cases, dangerous to health. Thus, attempts are made to augment its weight by mixing heavy-spar or plaster of Paris with it, or to increase its bulk by the addition of the products of overgrown corn, which are less suitable for baking purposes, or of the seeds of wild plants. Furthermore, the purity of the flour may be injured by want of care in the collection, and subsequent treatment of the corn, allowing foreign seeds of all kinds to mix with it. Adulteration with ergot (a fungus growth on the ear of corn), is especially to be dreaded, as it usually produces poisonous effects when eaten.

§ **61. Cooking of Flour—Baking.**—Flour is used in food of many kinds. It forms the essential constituent of many dumplings—the Swabian "Spätzle," the Bavarian "Knödel," vermicelli, and macaroni, and is well assimilated by our digestive organs when so prepared. Many people also prefer porridge as a morning diet, but the chief use of flour is in baking.

The process of baking bread is conducted in the following manner:—First of all the flour is kneaded into at dough with water, and this dough is mixed with yeast. (Yeast (Fig. 24) is a mass consisting of minute living vegetable structures, only visible to the microscope, called fungi.) As dough begins to "rise," numerous bubbles form in its interior, it becomes spongy and light; in this condition it is put into the hot baking oven, where it at first increases in size, and after a short time, the bread is baked. In bread the hard, brown crust is distinct from the soft, light crumb pierced by numerous large and small

cavities; the colour of the latter, according to the kind of corn employed, is sometimes white, sometimes grey, and sometimes brown.

The conversion of the dough into bread is brought about chiefly by the agency of the yeast fungi: first of all these change a part of the starch into sugar, and thus immediately give rise to a process of fermentation by which the sugar is split up into carbonic acid and alcohol. The carbonic acid gas and the alcoholic vapour expand the dough, and impart to it its light, spongy character. In the baking oven, the yeast fungi continue their fermentive activity until they perish under the influence of the increasing heat.

Instead of yeast there is sometimes used in the preparation of bread what is called "leaven," *i.e.*, fermenting dough from an earlier batch of bread. The yeast fungi, already in full operation in the "leaven," are increased when fresh dough is kneaded with the latter, and thus produce the same phenomena as pure yeast.

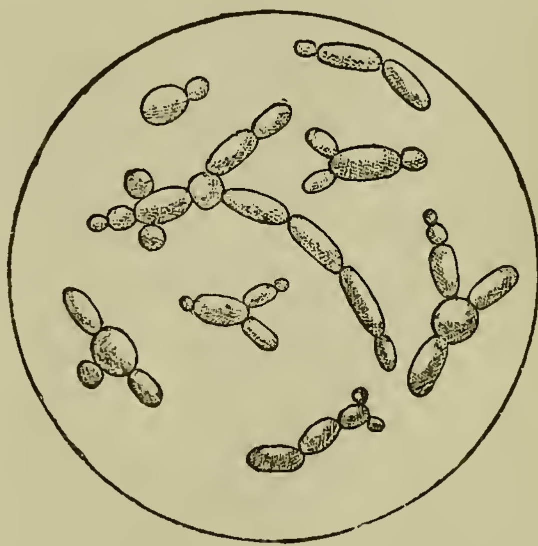


Fig. 24.
Yeast Fungi (greatly magnified).

In the fermentation set up through the agency of yeast or leaven, organic acids, especially lactic acid, are constantly being formed: these impart a more or less acid taste to the bread, and sometimes produce digestive disorders in the human body after eating bread. To avoid this formation of acids in bread, the yeast used in baking is sometimes replaced by certain salts which possess the property—under the influence of heat or by chemical action on one another,—of producing gases, especially carbonic,

and, accordingly, make the dough spongy in the same way as yeast. Salts of this kind are contained in the numerous baking-powders used at present. Carbonate of ammonia can be added to dough by itself.

§ **62. Different kinds of Bread.**—The properties of bread depend on the one hand on the class of cereal used, and on the other on the quality of the flour: in regard to the latter, the manner in which the corn is ground is important. It has been found that the nutritive substances are not distributed uniformly in the grain of cereals. Albumen and salts are to be met chiefly in the outer layers. Starch especially in the interior. As in grinding a complete separation of the grain from the husk is impossible, even with the aid of the most perfect milling machinery, a certain quantity of the external layers of grain remain adhering to the cellular husk after milling, forming with it the mill-stuffs known as bran and pollard. Hence flour is poorer in albumen and salts than the corn in grain. This is especially the case with the absolutely white flour, which the miller obtains by removing larger quantities of the external glutinous layers of the grain, which impart a grey colour to the flour.

We must now consider whether it would not increase the nutritive value of bread if the flour were baked along with the bran, as has hitherto been usual in the case of coarse rye-bread, and thus the nutritive substances adhering to the bran would be turned to account. The bran, however, contains indigestible substances, which not only irritate the stomach and intestines, but may even by accumulation, produce disorders in the digestive organs. While of Munich rye-bread 89·9 per cent. and of wheaten-bread 94·4 per cent of their weight can be digested, only 80·7 per cent. of coarse rye-bread is available for nutriment—a fact which entirely outweighs the

advantage of its greater percentage of nutritive elements. Nevertheless, the bran-bread forms a favourite article of food of many men whose digestive organs are healthy and strong, and nothing can be urged against its use so long as it is well received by the stomach, and does not interfere with digestion.

Among different kinds of bread, leavened bread is distinguished from unleavened, which is baked without the use of yeast or leaven. Wheaten bread is the best, and in its preparation some milk or butter is usually mixed with the dough, kneaded from wheaten flour and yeast or leaven. The black bread, in some places called grey bread, is baked either from rye flour, or from a mixture of rye flour and wheaten flour, with the aid of leaven. The dough of the soldier's "ammunition-bread" and of the Westphalian rye-bread is prepared by the help of leaven from coarsely ground rye, partly mixed with bran. Instances of unleavened bread are "Graham's-bread," which is prepared from coarsely ground wheat or rye and maize, without the help of anything to make it rise; and ship's-biscuit, prepared flour without any bran.

§ **63. Cakes and Tarts.**—Cakes and tarts are made in the same way as bread by baking, but in addition to flour, milk, butter, eggs, raisins, nutmeg, almonds, and various kinds of spices are used: the raising is effected sometimes by yeast, sometimes by baking powder or carbonate of soda. As the same kinds and quantities of ingredients are not used in the various classes of confectionery, their nutritive value and digestible qualities are very dissimilar. In general, the less coherent and more fatty puff-paste, is especially hard to digest.

§ **64. The different Kinds of Corn.**—As the value of bakers' food generally, and of bread in

particular, depends in a great part on the kind of grain used in their production, it is of no small importance for the sustenance of the people of a country, the grain that flourishes best in the soil and climate of the country, and hence can be most cheaply obtained from the agricultural class.

The chief cereal of the temperate zone is wheat. Its cultivation extends in Europe, over Germany, England, Central and Southern France, Hungary, the Balkan countries, the Crimea, and the Caucasus. It also thrives in Central Asia, a part of North and South America, and at the Cape of Good Hope. Among the other cereals, rye is chiefly used in Germany for human support. It endures a colder climate and lighter soil than wheat, and is cultivated in a great part of the temperate zone in Europe, Asia, and America. Rye and wheat are distinguished, in their nutritive value, by the somewhat greater amount of albumen contained in wheat.

Wheaten bread is universally used in France, England, and the South of Europe, and in Germany, by the comfortable classes. Owing to its lightness, which facilitates its assimilation in digestion, it has in fact, some advantages over rye-bread, yet the latter is justly a favourite food among many classes of the people in Germany and the North of Europe.

Another cereal, barley, is largely used for making bread in the North of Russia, Great Britain, and Scandinavia. In Germany it is mostly employed in the beer breweries. Sometimes it is added to rye or wheaten dough to produce a cheaper bread. In a prepared form as pearl-barley, it is used in soup and gruel.

Oats, so much esteemed as a cereal in Scandinavia and Scotland, is used for human food in Germany, chiefly as water-gruel and groats.

In China, Japan, and Southern Asia generally, and in

most African countries, rice is the most widely-spread cereal, and the almost exclusive support of the poorer classes. It seems especially fitted for sustenance, because it is cheap, surpasses in nutritive value other cheap provisions, such as potatoes, and is completely assimilated by the human organs of digestion. It has, however, been observed among the inhabitants of these countries, that an exclusively rice diet has the same disadvantages for the human body, as every exclusive vegetable diet. If a man living only on rice does not consume a relatively large quantity of that food, which may be unsupportable by his digestive organs, he cannot satisfy his need of albumen ; he loses working and vital power, and suffers injury to his health, far more easily than with a mixed diet.

Maize (Turkish wheat) which is distinguished from other cereals by the large quantity of fat it contains, is especially cultivated in Southern Europe, Central America, and a part of North America. In Italy a part of the population lives almost exclusively on a broth made from maize flour called "polenta." In Germany maize thrives poorly, hence it is of little importance there, as also is millet, which serves as food for the inhabitants of Egypt and Algiers. In connection with the bread stuffs, buck wheat must be mentioned, though it does not belong botanically to the cereals, but to the family of polygonaceæ. In its nutritive value it resembles the bread stuffs. Buck wheat has also the advantage of thriving in countries which on account of a cold climate and short summer, or of the bad qualities of the soil, do not allow the cereals to come to maturity. It grows on the cold Siberian steppes, on the great moors of the low-lying plains of North-West Germany, and in Poland, and it is well known in Styria and in North America. Besides its use as bread, it is employed as flour in preparing gruel and other farinaceous dishes.

§ **65. Pulses.**—Besides corn, pulses or leguminous plants, especially peas, beans, and lentils form a valuable source of nutriment belonging to the vegetable kingdom, as they possess the advantage of cheapness and nourishing properties. The pulse which we obtain from some plants belonging to the papilionaceous order, contains in a formed condition all the nutritive elements in such relatively considerable quantities, that they can in a certain measure replace the foods derived from the animal kingdom. Dried peas, beans or lentils, contain about 25°/₀ of their weight of albumen, and perhaps 50°/₀ of starch-flour, while young peas and green beans, in respect of their nutritive value, must be reckoned among the vegetables, as occupying a high place. As the albumen of pulse, called legumin, is of a different kind to the gluten of cereals, and is not adapted for baking, we eat peas, beans, and lentils, mostly in the form of soup or broth. One disadvantage is, the husks which consist of indigestible tissue, and easily become injurious to the stomach and intestines. It is usual therefore to pass the cooked broth through a sieve which retains the husks, or to use the flour of these vegetables freed from the husk, which is an article of commerce. A further disadvantage of pulses is that they cannot be boiled soft in hard or chalky water, because the legumin enters into an insoluble combination with the chalk. In their preparation, therefore, soft or rain water must be used, or where these are not procurable, the hard water is made soft by the addition of some soda.

The value of pulses as a food, is injured by their absorbing a considerable quantity of water in boiling, and thus they occupy a space disproportionate to the amount of nutritive elements they contain. Hence dishes prepared from them overload the stomach and intestines by their bulk. Moreover, the repugnance felt by many men to the

constant use of peas, beans or lentils, causes neglect for leguminous food in comparison with cereal.

§ **66. Oil-Products.**—While the nutritive value of cereals and pulse, depends especially on the albumen and carbohydrates they contain, other products of the vegetable kingdom are distinguished by their fat. Thus, from the seeds of certain fruits, fatty oil is pressed which we are accustomed to add to our dishes. The oil most extensively employed for this purpose is olive oil, which is obtained in Southern Europe from the olive, the fruit of the olive tree. For the poorer inhabitants of Southern France, Italy, and Greece, it takes the place of butter, while with us it is highly esteemed in the preparation of dainty dishes, especially salads. In addition, poppy oil, linseed oil, and some other oils are used in our food, and may be obtained in Germany. Olive oil is largely adulterated by American cotton seed oil. As a substitute for butter, the fat procured from the seed of the cocoa nut palm, has been lately recommended, and it has been tried in cooking (cocoa butter).

§ **67. Potatoes, Green Vegetables.**—Besides the products already mentioned, the vegetable kingdom affords a rich and varied food-supply in roots, bulbs, leaves, and flowers Potatoes are known to everyone as a wide spread article of diet. They grow underground as bulbous expansions of the stem of the potato plant, which was brought to our continent from America towards the end of the 16th century, and has been cultivated in Germany for about 150 years. The value of potatoes depends on their savouriness and their starch, which forms about one-fifth of their weight, but they are inferior to cereals and pulse, as they contain albumen and fat only in small quantities, and three-fourths of their weight is water. The potato is eminently suited to be an adjunct to other food rich in albumen and fat, but is not sufficient as an exclu-

sive diet. It is most easily digested in the form of mashed potatoes mixed with milk and butter.

§ **68.**—The fresh or green vegetables have been brought to perfection from the state of wild plants through the industry of the agriculturist, or the skill of the gardener. To this class belong the green—*i.e.*, unripe or half-ripe fruit of peas and beans already mentioned ; and in addition, among bulbous plants, carrots, turnips, rape, beetroot, comfrey, in addition to the different kinds of cabbage—curly cabbage, white cabbage, red cabbage, green or brown kale, cauliflower, and turnips. Lastly must be mentioned spinach, asparagus, and artichokes. Among the vegetables are included the salad plants (lettuce, endive salad, watercress), cucumbers, celery, onions, radishes, and numerous herbs such as parsley, leek, chervil, and dill, which are employed in the preparation of broths and solid foods.

All these products of the vegetable kingdom possess only a limited nutritive value, in consequence of the large amount of water they contain in proportion to other sources of nourishment. As is evident from the coloured table (Fig. 23), potatoes contain 88 per cent. of water, salad as much as 94 per cent., and the water in cucumbers amounts to 96 per cent. in weight. Nevertheless, their importance as foods must not be undervalued: we choose them on account, partly of their savouriness, partly of their pleasant odour, not only as an adjunct to other more nourishing foods, but because they stimulate the appetite and aid digestion. By means of certain elements they contain, especially malic, and oxalic salts, they produce an increased secretion of gastric juices, and a vigorous action of the stomach and intestines. They are by no means completely devoid of nutritive elements: potatoes contain $6\frac{1}{2}$ per cent. of carbohydrates, green beans $7\frac{1}{2}$ per cent., and young peas as much as 12 per cent. ; carrots provide us with a notice-

able quantity of ready-made sugar, and in green beans and young peas we consume quantities of albumen amounting to 6½ or 5½ per cent. of their weight. Of course, in the ordinary method of cooking vegetables, a large part of their nutritive elements is lost, since the water in which they are boiled, and which absorbs the soluble effective constituents of this class of food, is generally thrown away.

As fresh vegetables cannot be procured at all times, and in all places, a method has been devised for preserving them a considerable time, in an edible condition, and for sending them long distances. For this purpose it is necessary, that the vegetables should be freed from the germs of fermentation and decomposition present in them, and then be protected from the subsequent ingress of such germs. This end is best attained by exposing the vegetables to boiling heat in vessels of glass or tin, and then at once hermetically sealing up the latter. By the preparation of dried vegetables, and the vegetable tablets compressed out of these, we succeed in lessening the amount of water contained in the fresh vegetables, and chances of their decomposition. In Germany, too, the favourite "sauerkraut" has long been in use; it is prepared by allowing chopped cabbage to undergo thorough fermentation with sour milk.

§ **69. Fungi.**—A means of nutriment resembling vegetables, are the edible fungi or spores which are eaten by the common people in many districts of Germany, in Bohemia, Hungary, the Balkhan countries, Upper Italy, and Russia. We are acquainted with about 40 edible kinds of fungi, while, on the other hand, we know 11 poisonous species. Of the group of the cap-fungi, the most valuable edible fungi are the true orange agaricus, the golden agaricus, the yeast fungus, the hawk weed, the yellow argaricus, the mushroom, and the yellow boletus. Among the sack-fungi the most valuable are the truffles and morels,

among the puff-balls the red and yellow puff-balls, and the common and potato "bovist." The two last named fungi are suitable for cooking, only in their earliest development, because they fall into powder in their maturity, they are sometimes falsely offered as truffles.

Among the poisonous fungi are the agaricus piperatus, the toad stool, and the poisonous orange agaricus, belonging to the cap-fungi, and the "turban-top" of the sack species which often cause poisonous results owing to their resemblance to morels.

Some of the fungi (*e.g.*, morels and yellow agaricus), grow chiefly in forests, others as mushrooms, especially in meadows and grassy places. Fungi are collected either in the spring, like the morels, or in the latter part of summer and in autumn, like the mushrooms : they appear in large quantities more particularly after warm rain. In collecting them they should not be torn out by the roots, but cut off at their lower part, and the stalk covered with earth, so that the part remaining behind in the ground is preserved for future growth. Fungi that have been eaten by insects should be avoided, and young ones in particular collected. As fungi quickly decay, and thus become injurious to health, it is advisable to cook, or dry, or preserve them, soon after they have been collected. This is especially so with fungi that have been collected during rain, because these quickly decompose under the influence of the rain water they have absorbed.

Most fungi have a composition similar to that of fresh vegetables ; as however they contain particularly large quantities of nitrogen, and are completely free from starch, it has been assumed that they may afford a substitute for animal nutrients, especially meat. This is however an error, for fungi are not easily digested, because they contain their nitrogen only partly in the form of albumen,

partly in the shape of other compounds, that cannot be employed in nutrition, and hence are only incompletely assimilated in the human intestines. Hence it is correct to consider fungi as similar to vegetables in respect of their value as a food.

The unedible fungi owe their injurious effects to strong poisons, among which the poison of the toad stool (muscarine) has been most carefully examined. The mixture of edible and poisonous fungi has already resulted in numerous cases of sickness and death, and hence the sale of fungi has in some places been placed under police supervision. In Austria there are market inspectors specially appointed for this purpose. The marks distinguishing edible from poisonous fungi have been repeatedly brought before the public, because the popular tests are deceitful. For neither in the presence of milky juice, nor in the bright colours, or the glutinous property of the cap, just as little as in the turning black of an onion boiled with them, the turning brown of a silver spoon dipped into them, nor in the fact that salt becomes yellow, is there a sufficient and reliable indication for deciding on the properties of fungi. We can be quite certain, only if we acquire an accurate knowledge of the distinctive marks of the edible, and poisonous fungi, and reject all doubtful specimens.

The injurious effect of eating poisonous fungi reveals itself after 4 or 5 hours. Pains in the limbs, stomach, and intestines, are followed by vomiting, along with nausea and cramp, pain increases, raging thirst, palpitation of the heart, dizziness, and faintness set in ; finally, death results from cessation of the heart's action and convulsions. The treatment, in cases of poisoning by fungi, is the same as are given in § 234, for poisoning by so-called narcotic poisons.

§ **70. Fruit.**—Fruit occupies a position midway

between nutritive food and luxuries. We partake of it less for the purpose of nourishing, than of refreshing ourselves by its flavour, at the same time, the usually pleasant odour of the fruit delight us. However, fruit also contains nutritive elements, especially sugar, and also, substances useful to digestion. To the latter belong the vegetable acids which cause the flavour of fruit.

Fruit may be divided into three groups :—(1). Kernel-fruit, like apples, pears, quinces, and oranges. (2). Stone-fruit, as cherries, plums, apricots, and peaches. (3). Berries, as grapes, white currants, strawberries, raspberries, gooseberries, huckleberries, and cranberries. To these kinds of fruit may be added the shell-fruit, distinguished by the carbohydrates and fat it contains (*e.g.*, almonds and nuts), and a series of other fruits of different origin, such as melons, figs, pine-apples, bananas, &c. With few exceptions, among which are quinces and cranberries, fruit may be eaten as well fresh, as cooked. To preserve fruit in edible condition for a long period, various devices are resorted to, as with vegetables. By drying under gentle heat, we obtain dried apples, pears, and plums, and from grapes we get raisins ; by boiling with sugar, and keeping them in air-tight vessels, we obtain preserved fruit. The juice pressed from cherries and berries is boiled with sugar, to form fruit-jelly. Finally, by thickening the juice, apples, plums, pears, and grapes, the fruit-kraut or Rhenish kraut, and is obtained in many districts. As all these products retain their vegetable acids, they act on our digestion in the same way as fresh fruit ; but, in so far as by drying and preserving, the amount of nutritive elements, especially of sugar, is proportionately increased by the removal of water, they surpass fresh fruit in nutritive value.

§ **71. Sugar.**—By suitable treatment of the juice of many fruits, the sugar contained in them can be obtained

in its purity. A class of sugar produced in this way is grape-sugar, which, however, is largely derived, not from fruit or grape juice, but from potatoes, by allowing diluted sulphuric acid to act on the starch procured from the latter. The resulting product called starch-sugar is known as an article of commerce, both in the solid state, as also in the form of a thick fluid, "starch-sugar syrup."

Neither grape nor starch sugar serves for ordinary use, but the class of sugar known as cane or beet sugar. It was originally prepared from the expressed juice of the sugar-cane that grows in the tropics, but at present it is obtained in Germany, France, Belgium, and Russia from the juice of the beetroot, after the latter has been cut up, rolled and compressed. According to its greater or less purity, beetroot sugar is called refined sugar, loaf sugar, lump sugar, or soft sugar. If a solution of beet sugar is allowed to crystallise on threads suspended in it, we obtain "sugar candy."

Sugar is of considerable importance for human nutriment, for it is directly absorbed in the body as a nutritive substance, as it is not—like other sources of nutriment—separated by the agency of the organs of digestion.

An allied product obtained in the manufacture of cane sugar is molasses, which is used in cooking, and is willingly eaten by children with bread in place of butter. The so-called "barley sugar" is produced as a glassy mass, if freshly prepared, thick sugar-syrup is boiled, and then allowed to cool suddenly.

As the manufactured sugar possesses generally a light yellow colour, some blue ultramarine is frequently added to it to make it appear white. Sugar of this kind cannot be used in preserves, because the ultramarine produces, with the vegetable acids contained in the fruit, foul-smelling and poisonous sulphuretted hydrogen gas.

Besides the sap of fruit, sugar-cane and beetroot, the saps of various other plants (maple, &c.) contain sugar. Similarly the animal kingdom affords us a class of sugar —the sugar contained in milk.

§ **72. Honey**.—Honey is closely allied to sugar. It consists chiefly of a mixture of grape-sugar and another kind of sugar; contains, moreover, water as well as small quantities of albumen, formic acid and salts. It is sucked by the working bees from the flowers of many plants, and brought to the bee-hive, from the honeycomb of which it is obtained. The best honey is the virgin honey which flows spontaneously out of the comb, or is separated from it by the aid of a honey-shaker. The rough honey obtained by squeezing and heating the comb is less valuable. Adulterations of honey with starch, sugar and syrup are frequent.

Honey is not only a valuable means of nutriment on account of the sugar it contains, but also as an aid to digestion. We use it generally in its purity along with bread or fresh rolls; it is also baked with flour and spices to form spice cake or gingerbread. By the fermentation of a mixture of honey and water is produced mead, a beverage greatly favoured in former times. In some rare cases poisonous effects have been observed after eating honey that had probably been collected by the bees from poisonous flowers.

§ **73. Confectionery**.—Honey and sugar are used in many ways in the preparation of the bonbons, comfits, and other sweetmeats sold in confectioners' shops. All these confections are popular with many persons on account of their pleasant taste; still, large and frequent consumption of them may lead to diseases in the teeth, and disorders in the digestive functions, and sometimes these sweetmeats contain unhealthy adulterations. Thus many

confectioners increase the weight of their cheaper wares by adding entirely indigestible, and therefore specially injurious substances, such as heavy spar, plaster of Paris, and similar bodies. The almond flavour of some confections is frequently produced by means of oil of mirbane, which possesses poisonous qualities.

§ 74. **Animal Food.**—As compared with the foods derived from the vegetable kingdom, already indicated, the nutritive supplies from the animal kingdom have the advantage of supplying us with albumen and fat in a form especially easy of assimilation by our body. Most of these foods are also distinguished by the high percentage of nitrogenous nutritive elements that they contain, many also by their richness in fat, while carbohydrates are altogether wanting in them. However there is one food derived from the animal kingdom which contains all the nutritive elements necessary for the support of the body, and which therefore, is alone able to maintain and promote the growth of the body in the first period of life : this is milk.

§ 75. **Milk.**—Milk is secreted by the lactic glands which in animals are called udders. We generally use cow's milk, yet among other nations, and even among ourselves, the milk of the sheep, the goat, the horse, and the ass is used for human sustenance. Cow's milk is a white fluid which indicates a greater or less percentage of fat by presenting a yellowish or bluish tint : it possesses a sweet taste and consists of water, solid constituents dissolved in it, and fat. In the solid constituents are included various albuminous bodies, among them especially casein, and also carbohydrates, milk sugar, and some salts. The fat floats in the milk in the form of innumerable small balls or fat globules, only visible by the microscope. In

the stomach the casein at first coagulates in fine flakes which are dissolved by the gastric juice. On account of the solid constituents it contains, milk is heavier than water, but every milk is not equally heavy. The weight of a litre of milk varies from 1,026 to 1,040 grammes: a litre of water weighs 1,000 grammes.

The proportion by weight in which the various constituents are contained in milk, is influenced by the nutritive character of the fodder supplied to the beasts, especially by the quantity and digestibility of the nitrogenous substances furnished for consumption, by the quantity of water, and salt consumed by the animals, by the length of time that has elapsed since the secretion of the milk began, by the frequency and thoroughness of the milking, and by the breed of the cow.

Thus the contents of fresh cow's milk varies as follows:

	Water	Casein	Other Albuminous Substances	Fat	Milk Sugar	Salts	
Between and	83·97 91·50	1·17 5·74	0·04 5·04	2·04 6·17	2·00 6·10	0·34 0·98	per cent. of the total weight.

In general it must be observed that the average quantity of casein contained in cow's milk exceeds that contained in human milk, while the former contains less sugar and about the same amount of fat as the latter. Hence if it is desired to replace mother's milk by cow's milk for infants, it is advisable to dilute the latter in order to arrive at an equal percentage of albumen, and also to sweeten it with some sugar. The dilution is the more necessary for this reason, that the albumen of cow's milk is less easily digested than the albumen of mother's milk, and by its

greater quantity demands an increased activity of the gastric juice of the human infant, which may lead to severe illness.

During the first days of milk-secretion the cow's udder passes unmatured milk called "beastings" or "biestings," which is distinguished from the matured milk by a greater quantity of albumen and less of sugar. It appears as a thick yellow fluid that coagulates when heated, and is unfit for human food.

Even the matured milk may, under certain circumstances, possess qualities by which it is diminished in value, or even becomes injurious to health. When fed on fodder lacking in nutriment, or in consequence of diseases, the cows yield watery milk which is poor in albumen and fat, and exhibits a bluish colour. The milk may appear blood-coloured after the consumption of sharp resinous fodder, in certain diseases and after injuries to the udder. If the udder is inflamed the milk brings with it flakes, matter, or lumpy coagulated substances ; if the cattle have been fed on the fodder of certain bitter plants, the milk has a bitter taste, Many medicines administered to milch cows, and disease germs, especially of cattle murrain, which corresponds to consumption in men, and of the foot and mouth disease, may pass into the milk and become injurious if used by human beings. Disease germs can also get into the milk from the hands of the milkers, or generally through lack of cleanliness in the dairy arrangements. All such impurities are not easily noticed in the milk. Hence it is advisable to render them innocuous by heating the milk to boiling point, and to boil before use all milk of whose absolute purity we are not convinced by a knowledge of its source.

§ 76. Formation of Cream and souring of Milk.—A distinction is made between fresh (fat) cow's milk and skim milk which has been deprived for the most

part of its fat; for since the fat in milk that is left standing without being disturbed, rises to the surface in consequence of its lesser weight, there forms gradually (most quickly in warm weather), a layer of cream on the surface of the milk: this cream contains 22·46 per cent. in weight of fat, 4·22 per cent. of casein, 2·88 per cent. of milk-sugar, and 0·4 per cent of salts. If this layer is drawn off, or the milk is skimmed by means of special appliances (separators) there remains behind the skim-milk, which contains only 0·74 per cent. of fat, is heavier than fresh milk, and exhibits a bluish colour.

Besides the formation of cream, other changes take place in milk when it is left standing in the open air. Under the influence of yeast germs (*cf.* § 61) and bacteria which fall into it from the atmospheric dust, lactic acid and carbonic acid are produced from the milk sugar; at the same time the milk thickens as the casein separates itself from it: in this way arises sour or curdled milk. Some species of microscopic fungi which sometimes pass into the milk from the air can so destroy it, that it becomes entirely unfit for use, and even injurious to health: thus are produced those kinds of decomposed milk called blue, red, mucous, and thready milk.

§ **77. Preserved Milk.**—In various ways milk may be preserved fresh for a long period. For this purpose milk is treated according to Pasteur's method, by heating it for a short time to 70° or 75°C. and then cooling it. By this means the germs which cause milk to turn sour are destroyed and the milk retains its original taste; still disease germs that may be present are not destroyed with certainty.

In "sterilisation" (destruction of germs) the milk is heated for a longer time to 100°C. or for a short time to 120°C. According to the rule laid down by Soxhlet for sterilising

milk the flasks filled with milk are left for three quarters of an hour in a vessel filled with boiling water. The Laplanders and Mongolians obtain a keeping milk by boiling and then freezing it. Under the influence of this sterilising process, the fungi as well as the disease germs, contained in the milk are pretty certainly destroyed; still the milk undergoes changes which spoils its taste.

Condensed milk is obtained by vaporizing the water; in some factories it is preserved for a longer time by the addition of cane sugar. By mixing condensed milk with flour specially prepared from corn or pulse, the infants' foods so much in vogue are prepared.

If the milk treated by any of the processes described is to be kept fit for use for a long period, it must be protected against the renewed intrusion of atmospheric germs by being preserved in thick, hermetically closed vessels.

§ 78. **Adulterations of Milk.**—It must be regretfully admitted that milk is largely adulterated. Its quantity is increased by diluting it with skim-milk or water, or its value is lessened by removing the cream. Moreover, attempts are made to keep it fresh by adding soda, bicarbonate of soda, salicylic and boracic acids, &c. For detecting these reprehensible adulterations it is sufficient in many cases to ascertain the specific gravity of the milk, which is greater, the less fat it contains.

§ 79. **Butter.**—Butter is obtained from milk by thorough churning of the slightly-soured, or sweet cream, which causes a separation of the fat it contains, from the fluid constituents. The fatty lumps thus produced are collected, washed, and kneaded into butter. In many districts they try to attain a greater keeping quality in the butter by adding table salt. The butter obtained from sweet cream is

distinguished by its pleasant flavour from that produced from slightly soured cream, but it does not keep so well as the latter.

The table-butter intended for eating must contain as little casein and water as possible, must be firm, and correspond in its composition to the values given on the coloured diagram (Fig. 23). Less valuable butters may be used as cooking butter, without injury. Preserved butter is obtained by removing all casein from the fresh butter, by means of repeated washings, by mixing it with a larger quantity of table salt (from 3 to 10 per cent. of its weight), and then packing it in firkins. In South Germany and the adjoining mountainous countries it is usual to remove the casein from the butter by melting ; in this way the so-called melted butter is obtained. The more or less yellow colour of the butter depends on the quality of the fodder supplied to the cattle, but can also be artificially increased. The melting point of butter lies between 31° and 36°C., rarely between 41° and 42°C.

Fresh butter, on account of its pleasant flavour and its digestibility, is the most popular form of fat used as food. Old butter easily becomes rancid, while volatile fatty acids are formed which not only destroy the butter, but also irritate the mucous membrane of the digestive organs, and may give rise to sickness.

The refuse milk left behind after the butter is obtained is called butter-milk; this contains the nutritive elements, especially casein and milk sugar, and has a gentle purgative action.

Attempts have been made to replace butter by cheaper productions, known as artificial butter or margarine. In their manufacture the easily melted constituents (oleomargarine) are removed from heated beef fat by pressure, in order to be sold either pure or after being worked up

with milk: the stearine, which only melts at a higher temperature remains behind in the fat, and is applied to other purposes, especially to manufacturing candles.

§ **80. Cheese.**—Besides butter, milk yields us an important food, in cheese. This is obtained by allowing the casein in the milk to coagulate, separating it from the whey left behind, and then submitting it to further treatment, according to the class of cheese required. A distinction is made between super-fatty cheese, which is obtained from fresh thin milk, and the cream of the previous evening's milk: fatty cheese, in whose preparation ordinary milk is used, and lean cheese, in the making of which skim milk is employed. Besides, there are pressed and unpressed cheeses.

By means of the cheese-press the cheese is freed from those particles of whey, by whose fermentation it would otherwise decompose, and at the same time acquire a sharp unpleasant taste. The mild taste of Gloster and Cheshire cheese, is especially due to repeated and careful working-up and pressing. Unpressed cheese must be eaten fresh, unless we prefer to let it mature, that is, to pass into a state of fermentation, and then subject it to a further process by which it becomes durable, and acquires a decided taste. For this purpose it is treated with sour beer, certain vegetables, brandy, wine, oil, butter, damp straw, etc.

Moreover, many differences between various kinds of cheese depend on the manner in which the coagulation of the casein in the milk is produced. The separation of the casein is effected either by heating the milk, which has already become somewhat sour (sour milk cheese), or by the addition of acids, galgalls, etc., most frequently by calf-rennet. According to the kind of milk used we distinguish between cow, goat, sheep, etc., cheese: according to ex-

ternal qualities different kinds of cheese are called streaked, soft, hard, and grated.

Cheese is sometimes artificially coloured—*e.g.*, Edam cheese is usually streaked red on the surface. Adulterations of cheese are rare; still there is a bogus cheese manufactured from skim-milk and oleo-margarine. Old cheese easily decomposes when moths or maggots settle on it.

In consequence of its richness in albumen, cheese possesses double or triple the nutritive value of many kinds of meat: however, it is easily digested only, when it is well chewed. The sharp taste of many classes of cheese confines their use to occasional small quantities; such classes of cheese as Roquefort are selected chiefly as a savoury after meals. They excite the digestive organs to a larger secretion of their juices, in the same way as vegetables, and thus facilitate the digestion of food eaten before-hand.

The whey left behind in the manufacture of cheese also acts as an aid to digestion, and hence is employed in the so-called "whey-cures."

§ **81. Eggs.**—Besides milk and the products derived from it, eggs are one of the most important sources of nutriment in the animal world. Hens' eggs are most largely used; duck eggs, goose eggs, and turkey eggs are used in smaller quantities, while the eggs of the pheasant, the gull, and the plover, are eaten only as dainties on account of their high price.

Hen eggs consist of the yolk, the yolk skin, the albumen, or white, the shell skin, and the shell. In the yolk, immediately under the yolk skin, is a small white disc, the germ-disc (eye of the egg). The white of the egg is a thick fluid. The shell-skin consists of two layers that separate from one another at the thick end of the egg, and thus enclose a

space full of air. The shell consists almost entirely of carbonate of lime: it is pierced by fine holes which allow free passage to the air.

A hen's egg weighs on an average 60 grammes, of which two-thirds may be credited to the white, and one-third to the yolk. From the albumen it contains, it corresponds in nutritive value to about 40 grammes of meat, or 150 grammes of cow's milk. The fat it contains amounts to about one-tenth of its weight, and it contains no starch or sugar.

The albumen of the egg coagulates as soon as it is exposed to the gastric juices. For this reason a hard-boiled egg, in which the albumen has already coagulated, is not in itself more difficult of digestion than a raw or soft-boiled egg. However, the circumstance that the albumen of the latter coagulates in the stomach in thin flakes, which present a greater surface to the action of the digestive juices, favours digestion under ordinary conditions.

Fresh eggs are savoury, clear, and transparent, old eggs are dull, non-transparent, and, when musty, have a bad, foul smell. Fresh eggs are heavier than water, and, therefore sink in it. Rotten and hatched eggs float on the surface because they contain air.

In order to keep eggs fresh for a long time they must be placed in stands provided with holes, in which they are put with the smaller end downwards. Necessary conditions are, that the egg shell is intact, and that the egg has not been already hatched.

Eggs may also be kept fresh by rubbing them over with greese, oil, melted wax, or shellac varnish, or by laying them in melted paraffin, ashes, or dry sand. All these devices succeed in keeping out air and moisture from the eggs.

Eggs may contain foreign bodies, such as feathers,

grains of sand, parts of insects, small worms, coagulated albumen, or blood, and others, which cause them to decompose quickly.

§ **82. Meat.**—By meat, as a source of nutriment, is understood the edible parts of animals, especially the muscles, along with the fat of the large organs and other parts of the animals, the heart, lungs, liver, kidneys, spleen brain, tongue, sweet-bread, breast, and blood, are employed for food. The principal animals whose flesh we eat are, the ox, sheep, pig, poultry, and wild game.

The paramount importance which meat possesses for human sustenance, is due to the relatively large quantities, and the easily digestible form of the albumen it contains, In addition, it contains salts, and under certain circumstances considerable quantities of fat, but it has no carbohydrates.

The good quality, savouriness, and nutritive value of meat, depend on the class, age, and sex, on the kind of feeding and manner of foddering the animal, as well as on the part of its body from which it is taken. That of young animals, is, as a rule, soft, tender, and of a blood-red colour; that of older animals is poor in fat, tough, and darker-coloured. This is especially true of poultry, which is most tender and savoury in the first year of the bird's life. By certain kinds of fodder, known as fattening, the proportion of water in the meat is reduced, while the fat is increased. The peculiar flavour of venison, known as "haut goût" may be traced to a special chemical property of deer flesh, as well as to the first symptoms of decomposition, which usually sets in rapidly in the case of animals that have been hunted.

The flesh of the calf, hen, and pigeon (which is poor in fat, and is called "white meat" on account of the colour it assumes after boiling), as well as venison, and tender lean

beef, are most easily digested, while the other kinds of meat make greater demands on the activity of our digestive organs. Very fat and sinewy meat is most difficult to digest. The heart, tongue, liver, kidneys, and brain of our slaughtered animals are generally digested without difficulty, if they cannot be exactly reckoned among foods easy of assimilation. The eating of the lungs of cattle and sheep, and of "pâte de foie gras," can be recommended only to those who rejoice in healthy digestive organs.

§ **83. Flesh of Diseased Animals—Meat Parasites.**—From the diseases of animals, their flesh suffers various changes. It can be bloody, watery, or purulent; it may contain animal or vegetable parasites. Of the former the "trichina spiralis," cysts, the case-worm, liver fluke, and lung-worms, are of importance, of the latter the "actinomycosis."

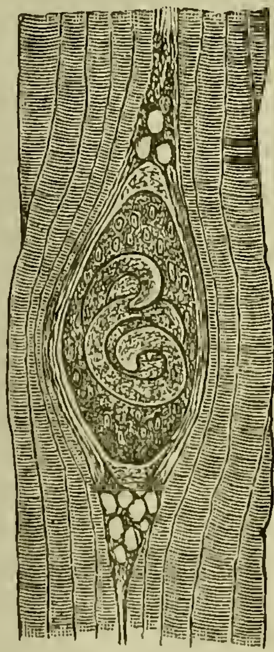


Fig. 25.
Trichina Encysted.
(greatly magnified).

The "trichina spiralis" is a small worm mostly found in swine. In its undeveloped or "larva" condition it is met with in the muscular flesh, and here it is enclosed in small capsules (Fig. 25), imbedded in the muscular fibres; hatched in time, it becomes visible to the naked eye as small white dots. The "trichina" remains alive for a long time in the hatching-capsule, and withstands even long, the influence of cold, as well as mild pickling and curing. If meat permeated by "trichinæ," is eaten by man, uncooked, the capsules are dissolved in the gastric juices and the worms thus set free, increase to considerable numbers within the intestines in a short time. The young "trichinæ" pass through the sides of the intestines into the muscular flesh,

spread through the latter, and roll themselves tightly together in order to generate others. The symptoms of illness are developed by the multiplication and migration of "trichinæ" through the human body; these exhibit themselves as nausea, vomiting, pains in the stomach and muscles, diarrhœa, and fever, and frequently lead to death.

Among "cysts," the most important for us are, the pig-cysts and cow-cysts. They appear as blebs, ranging in size from a pea to a bean, and containing water: through the side of the bleb, the crushed-up head of the worm appears, as a yellow spot of the size of a hemp-seed (Fig. 26). In this is observed by the microscope four suckers: in the swine cyst in addition there is a double hooked "corona." The cysts in swine and cattle generally appear in the connecting tissue which divides the single muscles, and groups of muscles. If they are eaten with raw meat they attach themselves firmly by their suckers and hooked "coronæ" to the inner side of the intestines, so as to grow into the "tape-worms," sometimes several metres long, since new members are always being added on. The presence of a tape-worm (Fig. 28) in the intestines, may give occasion to manifold inconveniences, such as bodily pains, loss of appetite, nausea, costiveness, diarrhœa, and produce serious digestive disorders.

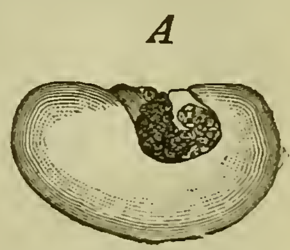


Fig. 26.
Cyst Germ with Inturned Head (Magnified).

Fig. 27.
Measles (head of), (greatly magnified).

"Actinomycosis" sometimes cause swellings in cattle and swine, in which they lie scattered as small yellow dots about the size of a grain of gravel. In swine flesh, other structures similar to these actinomycosis are frequently met with. Even in men, actino-

mycosis are sometimes the cause of severe illness, united with festering, which, among other effects, destroy the bones; as a rule, it obtains entrance through decayed teeth. A passage of these actinomycosis by eating the flesh of animals affected with them, does not occur so far as our experience goes up to the present.

§ 84. Decayed Meat, Inspection of Meat.—Besides the diseases of slaughtered animals, other circumstances such as decomposition, mouldiness, or improper slaughtering, may injure the savoury qualities, or value of meat. All meat is to be regarded as tainted, which is unclean, discoloured or dirty, possesses a revolting smell, or otherwise displays unusual characteristics. Approaching decomposition is frequently indicated, by a dark purple colour in the meat.

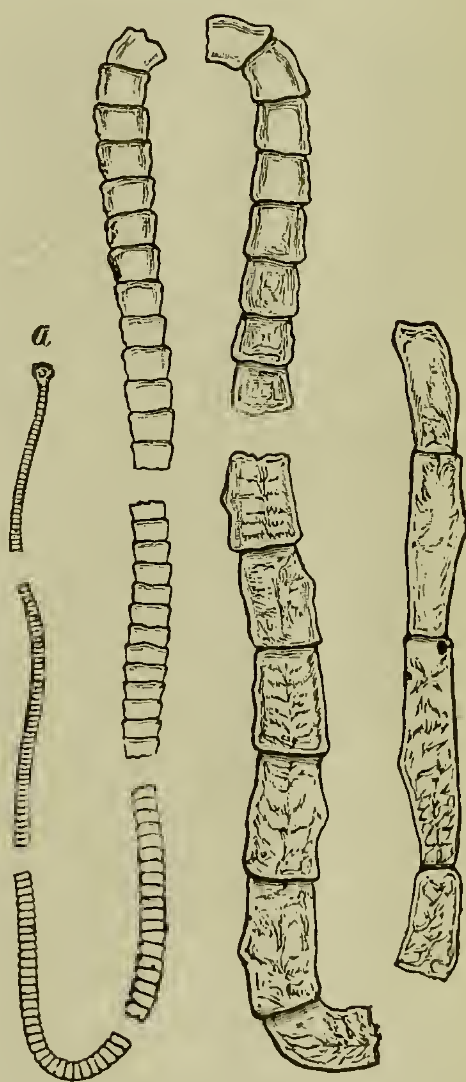


Fig. 28.
Pieces of a Tape-worm.
a. Head.

As meat is calculated to cause digestive disorders by diseased or tainted conditions: if it has a nauseating character, or if it comes from animals which immediately before slaughtering were suffering from diseases communicable to men, it must, as a rule, be rejected as dangerous to health. To protect the people from using such, there is in many countries an inspection, by skilled persons, of cattle, meat, and animals to be slaughtered, so that only meat pronounced

good by them, may be offered for sale. If this inspection is to attain its purpose, the entrails of the slaughtered animals must always be examined, since disease is frequently revealed only by their condition. As a preventive to the eating of swine-flesh affected with "trichinæ" a microscopical examination of such meat is required in Germany in addition to the usual inspection.

§ **85. Preparation of Meat, Boiled Meat, Meat Soup, Stewing, Baking and Roasting.**—The dangers arising from animal and vegetable parasites, become especially important if the meat is eaten more or less raw, *e.g.*, as mince meat, smoked ham, or German sausage. The danger is generally obviated by thorough boiling or roasting.

Boiled meat may possess an entirely different quality according to the mode of its preparation. If it is put on the fire in a pot of cold water, it becomes thoroughly saturated, and loses a large proportion of its soluble constituents in the broth, especially if it has been previously cut into small pieces. This process of extraction is only interrupted, or limited, by increasing the heat so much that the albumen in the meat coagulates. If the meat is gradually raised to a boil in the water, we obtain a strong broth and a residue, which chiefly consists of the insoluble tissues and the coagulated albumen. The meat from which broth has been made is not altogether valueless, since it can still subserve the purposes of nutrition on account of the albumen it contains. If on the other hand, a larger piece of meat is placed in water already boiling, the albumen of the surface immediately coagulates, and forms an insoluble layer, which prevents the water entering the interior, and transferring the soluble constituents to the broth. It is advisable in this process to allow the water to act on it at boiling point only for about five minutes,

and then to reduce the heat to 70° or 80°C., so that it may not become tough, and difficult to digest, through too great a shrinkage of the muscular tissue. Thus, we obtain a weaker broth along with a more nutritive meat. The broth obtained by boiling contains numerous flakes, consisting of the coagulated albumen of the meat, and forming its most essential nutritive element. As these flakes are usually skimmed off in order to clarify the soup, and on account of their insipid taste, the broth is generally poor in nutritive elements, and insufficient as a means of subsistence; its value consists rather in a large quantity of salts, and soluble savoury substances, by means of which it stimulates the appetite and digestion.

The process of stewing is almost similar in its results to boiling, since the meat under the action of the steam, and of the richer sauce becomes more tender and juicy. In roasting, it is exposed to a great heat with a layer of fat spread on the bottom of a pan, and to prevent it being burnt is basted at intervals. In this way it gains in flavour and digestibility, without giving up any great quantity of its nutritive elements, the gravy arising from the fat, the water, and the juice of the meat. If it is roasted at an open fire, its salts, and savoury substances are almost completely preserved.

§ **86. Preserved Meat.**—As meat under ordinary circumstances quickly taints, and so becomes unfit for food, efforts have been made to preserve it fresh, by the use of various processes. For instance, it is preserved in ice, or in cooling rooms, since at the lower temperature the germs of decomposition do not usually develop; this however possesses the inconvenience, that the meat so cooled, easily becomes covered with moisture, and thus catches the germs of decomposition and fermentation from the air. This disadvantage is least apparent if it is en-

closed in canvas, and hung in a current of air, kept cool by proper appliances. It is then not only cooled by the air, but also dried on the surface, and is protected against the ingress of germs from the air, both by the wrapping, and the dry layer formed on the surface of the meat itself. Other processes for preserving consist, in cutting in long thin strips and drying it completely. These strips are then put up without further treatment, or cut into small pieces and are subsequently cooked and eaten.

A durable form of meat is "tinned corn beef," which has acquired an increasing popularity in recent times. In its preparation the meat, either alone, or with salt and fat added, is exposed in tinned vessels for some time to a boiling heat, or still higher temperature. The tins being hermetically closed by solder, can generally be preserved for a long time without their contents losing its flavour. In some exceptional cases, however, it has been observed, that the tinned meat, probably from want of care in its preparation, becomes tainted and dangerous to health, hence it is advisable before cooking or eating tinned meat to examine carefully its appearance and smell.

Tins, whose contents are tainted may frequently be known by the cover having been forced up by the foul gases formed inside ; the contents of such tins produce a splashing sound if shaken before opening.

For a long time we have known how to preserve meat in an edible condition by placing it in vinegar, milk, and other fluids. In recent times solutions of salicylic and boracic acids, sulphuric acid salts, and other chemicals, have been similiarly used, but their non-injurious effect on the human body has not yet been proved.

The processes of pickling, and smoking are ancient. In pickling, pieces are well rubbed with salt and saltpetre, placed in casks in layers, one over the other. The

salt removes the water from the meat, but also a portion of its nutritive elements, forming an unpalatable brine. Pickled meat keeps well, but must, on account of the large proportion of salt it contains, be steeped in water before being cooked. After long continued use of it, scurvy (a disease accompanied by acute inflammation of the mucous membrane of the mouth, and hemorrhage into the inner organs, and which frequently results in death), has been observed among sailors, soldiers, and others. For the purpose of smoking, the meat, usually salted beforehand, is hung in the smoke of burning or smouldering wood. It is thus deprived of water, and penetrated partly by the preserving elements of the smoke (*e.g.*, creosote and some volatile oils), which are destructive to the germs of decomposition.

The so-called quick smoking consists in smearing the pieces of meat several times, at definite intervals, with crude pyroxylic acid—which, like smoke, contains antiseptic elements—and then drying them in the air.

§ **87. Food Products Manufactured from Meat.**—Another method of cooking and preserving meat is the manufacture of German sausage. For this purpose it is cut small (and in various mixtures, with spices and sometimes bread, whole-meal, flour, etc.), is forced into the guts of slaughtered animals. The sausage is either eaten fresh, or after being first boiled, roasted, dried, or smoked. This sausage-manufacture admits of great variety, and nowhere does the art of sausage-making present such variety as in Germany, where the sausage enjoys a far greater popularity than elsewhere. The nutritive value and suitability of this means of sustenance, is often diminished by valueless additions: attempts are also made to give it an especially appetising appearance by artificial colouring.

Sausage insufficiently boiled or smoked, may prove injurious to health by reason of animal or vegetable parasites in the meat: the so-called "sausage-poisoning," which sets in after eating tainted sausage, is justly dreaded. Of the various kinds of sausage, the soft, partially smoked, or unsmoked products, are most easily exposed to decomposition.

Bacon, lard, and tallow, are special articles of commerce that must be included in the food substances derived from the animal world. The firm fat under the skin of pigs forms bacon, which is eaten raw, or boiled, but more usually smoked and salted, as a source of nutriment rich in fat. The lard usually consumed (pig's lard), is obtained from the intestines and also from bacon by a process of melting. It should be white and odourless, soft, melt at about 40° C. to a clear fluid, and solidify again at 20° C. It is best kept, with the addition of some salt, in a cool room, in earthenware, glass, or porcelain vessels, so as to prevent its becoming rancid. Beef tallow is firm and white in colour, melts only at 42° C. to 44° C., and becomes solid again at 34° C. It is more difficult to digest than butter, which, on account of its convenient character, is to be preferred as a means of nourishment to bacon and lard. Other ruminants also yield tallow (stag tallow, sheep tallow); still, these products are less often employed for the purposes of nourishment than beef tallow.

For more than twenty years, extract of meat has attained great importance. It is obtained by boiling minced meat and condensing the broth, and is used in place of meat-soup by dissolving it in warm water. It is similar to meat-soup, in nourishing qualities. Soup tablets, and other durable forms of food, are prepared by mixing with the flour of pulse, oats, and potatoes It is also baked with wheat flour as meat biscuits.

Peptonised meat, and jellies are also produced from meat. They contain, together with the salts and savoury substances, included in extract of meat, a portion of the albumen of the meat in a soluble form, and are more easily digested than meat. They have, however, this drawback that they excite repugnance in many after a long continued use.

§ 88. **Fish.**—In addition to the flesh of land animals the flesh of fishes forms a pleasant change in our food, and is similar in its nutritive value, and in general is as thoroughly digested and assimilated, as meat. A distinction must be made between the easily digestible and lean fishes, and the less digestible and fatty fishes. To the latter belong the salmon, herring, sprat, sardine, river lamprey, &c.; to the former, the pike, shell-fish, sole, &c. Sea fishes contain considerably more salt than fresh-water fishes.

In fresh fish, the gills are red, the eyes transparent and projecting, the flesh is firm, compact, elastic, smells freshly if the gills are opened, and possesses a white or ruddy colour. Fish from swampy water possesses less flavour, and is purposely kept several days in fresh water before being killed. In consequence of the presence of certain germs, fish sometimes become luminous in the dark. But this phenomenon disappears as soon as decomposition sets in, and does not indicate any qualities injurious to health. However, from other causes the eating of fish, may, sometimes give rise to injury to our health. Thus, with raw or insufficiently boiled or roasted pike, a germinal form of the so-called "Swiss tape-worm" is received into the system, and this multiplies in the human stomach in the same way as the worms of pork or beef. Again, parts of certain fishes contain poisonous substances, whose effects may be noticed (*e.g.*, in Barbel Cholera) in severe diarrhœa, fre-

quently observed after the eating of barbels. Moreover, the tendency of fish to speedy decomposition is dangerous, and occasionally causes poisoning after the consumption of fish no longer fresh.

Attempts are made to keep fish fresh for a longer time by placing it in ice. Other devices for a similar purpose are, drying (stock-fish), salting (herrings and sardines), smoking (eels, flounders, and red herrings), pickling, preserving in vinegar with spices (eels and herrings, anchovies, soles) or preserving in oil (sardines).

By the perfecting of our means of communication, it has become possible to send fish long distances, and thus make the rich treasures of the sea accessible to the inland inhabitants, in fresh condition at a moderate price.

Caviare is prepared from the roe of certain kinds of fish by salting. It affords a source of nourishment distinguished by a large proportion of albumen and fat, and also savory and stimulating to the appetite; on account of its relatively easy digestibility, it is frequently administered with success in many disorders of digestion and nutrition. In Russia caviare is obtained from the sturgeon, in Italy from the bull-head and tunny fish, in Norway from the cod fish and mackerel, in England and Sweden from salmon and cod fish, in Germany from the sturgeon and allied fishes. In the Dardanelles fish-roe cheese is obtained from the roe of many fishes by pressure.

Train oil is obtained from the blubber of large sea monsters by extraction. In commerce it is usually extracted from whales, sharks, seals, sea-dogs and dolphins. Cod-liver oil is manufactured from the livers of various fishes that have been dried in the air, and is employed as an auxiliary nourishment, especially with sick persons, and weakly children.

§ **89. Crustaceæ.**—Besides the fishes, the water also

shelters a number of "crustaceæ" which serve as food for man. Among these may be mentioned various kinds of cray fish, river-craw fish, crabs, shrimps, whelks and lobsters, whose flesh is prized as savoury, but is not easily digested and is not procurable at all seasons of the year. After eating shell fish, skin eruptions develop themselves in many persons, which are similar to the blotches caused by contact with nettles, and are therefore called "nettle rash."

Mussels and snails afford a source of nutriment favoured by many people ; oysters, cockles, and edible mussels, and the large vineyard snail, are especially used as food. Oysters are mostly eaten raw, and easily digested, contain much albumen, and some fat, and hence are suitable not only as dainties for the healthy, but occasionally as nourishment for sick persons, who cannot take other food. The mussels and snails are usually boiled before eating.

As shell-fish quickly decompose after death, thus producing dangerous putrid substances, and as under certain conditions, they also absorb poisonous impurities from the surrounding water, cases of poisoning are often observed after eating them. In particular edible mussels have frequently caused illness, and even death in human beings, since, after they have remained fourteen days in stagnant water, a poison forms in their liver ; this quickly disappears when they are replaced in running water.

§ **90. Seasonings, Salt, Vegetable Acids and Vinegar.**—Many of our means of subsistence require, in order to be palatable, or savoury, the addition of certain substances which by their smell and taste stimulate the appetite, and cause a plentiful secretion of the gastric juices ; they also produce a change in the form of the food provided. Seasonings and spices are employed for this purpose, Among the seasonings, common salt or chloride of sodium (a compound of the chemical elements chlorine and

sodium), occupies the first place. It is obtained partly from rock salt mines, partly from sea water, and brine springs. Common salt forms one of the indispensable necessaries of life, for it is a constituent of our body, is continuously being excreted from it, and must therefore be constantly replaced. In the case of persons who have exhausted their supply of salt, *e.g.*, in besieged fortresses, or on long journeys in uninhabited districts, a gnawing salt-hunger sets in.

Among the seasonings may be reckoned, sugar, nutrient oils, and various vegetable acids, *e.g.*, citron juice, citric-acid, and especially vinegar. The vinegar used for the purpose of food is chiefly produced in acetic fermentation, which appears under the action of a special fermenting agent, the so-called "mother of vinegar" in alcoholic fluids such as brandy, wine, beer, and diluted spirit. Recently pyroxylic acid has been used in a refined form as a seasoning; it is deposited by cooling the vapour ascending from highly heated wood. The so-called essence of vinegar (a fluid very rich in acetic acid and therefore very acrid), must be largely diluted if its use is not to be followed by injurious results.

§ **91. Spices**.—While seasonings can only be regarded as food under certain aspects, the importance of spices consists especially in their savouriness, and their power of stimulating digestion. They consist for the most part of the roots, leaves, flowers, buds, kernels, husks, bulbs, seeds, or fruits, of certain plants which on account of the etherial oils, resin, or other substances they contain, possess a distinctive odour or flavour. Many spice plants, such as onions, garlic, mustard, radish, juniper, dill, carroway seed, aniseed, saffron, are produced in our own country. Of foreign spices, black and white pepper, bay-leaf, ginger, capers, clove, all-spice, stellated anise, nutmeg, etc., are wanting in no well-kept kitchen. In general, imported spices have a

high price, and hence are frequently exposed to adulteration, especially if sold in a ground state. Recently, many spices are sold in the form of fluid extracts, containing the active elements of the spices.

§ **92. Luxuries.**—Luxuries are closely allied to spices in their importance for human sustenance; they are distinguished from them by being consumed, not as adjuncts to food, but independently of it, in an unmixed state. Among luxuries may be included, alcoholic beverages, coffee, tea, cocoa, and tobacco.

§ **93. Alcohol.**—Beverages containing spirits of wine or alcohol are, when taken in moderation, a valuable stimulant in aid of digestion, and are also used in many illnesses as a means for restoring strength, and vigour. Immoderation in their use not only leads to drunkenness, but also to debility in the functions of the stomach and intestines. After long continued indulgence in alcoholic drink, severe diseases of the digestive organs, of the kidneys, and the nervous system, usually make their appearance. Hence confirmed drinkers frequently meet with a premature death, or tedious sickness, and they are less able to overcome feverish illnesses than temperate persons.

Alcoholic liquors are obtained by allowing solutions of sugar to undergo fermentation under the influence of yeast. In this way, besides alcohol, carbonic acid, fusil oil, glycerine, succinic acid, as well as a series of other substances are formed. Among the products of a fermentation of this kind are wine, beer, and brandy. While wine, and beer can be consumed after fermentation without further special treatment, brandy must be obtained from the fermented fluid by distillation.

§ **94. Wine.**—Wine is obtained from grapes, the juice

being extracted, and collected in casks. In consequence of the increase of the yeast fungi already existing on the surface of the grapes, and therefore contained in the juice extracted, fermentation sets in, and under its action the sugar of the grape changes into alcohol and carbonic acid. A distinction is made between the primary, and the after fermentation. In the former, the greater part of the sugar present is decomposed along with a more or less violent formation of carbonic acid, in the latter, the decomposition of the sugar remaining after the primary fermentation proceeds slowly with a weaker development of carbonic acid ; at the same time the wine gains in bouquet and flavour. After some months the wine is transferred to vats, where it still further matures, till it is ready for bottling. In the production of red wine, the skins and kernels of red grapes are allowed to take part in the fermentation.

The so-called sweet wines, Malaga, etc., are obtained from the juice of particular grapes grown especially in southern countries. New wine of this kind yields in fermentation relatively large quantities of alcohol in proportion to its richness in sugar ; however some sugar always remains behind which does not take part in the fermentation and this imparts the sweetness to the wine.

Under unfavourable weather conditions, sufficient sugar is not formed in the grape to produce a wine in which the acidity has been sufficiently overcome. If we wish to obtain under such circumstances wine, rich in alcohol and less acid, sugar is added to the juice before fermentation.

If the grapes, after the first extraction of juice, are allowed to ferment with sugar, we obtain a poorer wine, forming a favourite domestic beverage. From raisins and water is obtained a vinous beverage called raisin wine.

These and many other products which have nothing in common with wine but the name, are largely sold as pure wine.

German wines contain from 7 to 12 per cent. of their weight of alcohol; other wines contain 18 per cent., and even more.

A particular class of wines is sparkling wine (champagnes), which were formerly manufactured especially in France, but at present are produced of excellent quality in Germany and other countries. In their manufacture, new wine, with added sugar, is allowed to ferment in flasks the tight corking of which prevents the escape of the carbonic acid gas produced.

In the manufacture of other vinous beverages, the so-called fruit-wines, gooseberries, currants, bilberries, apples, and pears, are chiefly used; the juice of these berries is allowed to ferment with sugar and water added.

Wine belongs to the alcoholic beverages most beneficial to our bodies; however, the individual kinds of wine are not of equal value especially in regard to their invigorating effects. Sparkling and sweet wines are suitable for invalids whose exhausted energies need to be recuperated as quickly as possible; white wines stimulate the peristaltic motion of the intestines. Red wines are recommended for many digestive disorders, and restrain an immoderate peristaltic motion. Less valuable products, such as poor and raisin wine, cannot serve as substitutes for wine in regard to its health-giving effects. Artificial wines may sometimes prove injurious to health on account of their ingredients.

§ **95. Beer.**—Beer contains less alcohol than wine. Of the materials used in beer-brewing, viz.—water, malt, hops, and yeast, malt is the most important. To prepare malt,

barley corn is allowed to germinate, and thus the so-called "diastase" is developed, which subsequently changes the starch in the barley into sugar. The "green malt" so produced is next turned into "kiln malt" by drying; it is then bruised after the germ is removed, and is finally mashed by mixing it thoroughly, first with tepid water, and then with hot water, inside a large vat. In this process malt sugar, dextrine, and other similar substances are produced. The fluid thus obtained, called "wort," is next boiled, whereby the operation of the diastase is brought to an end, and at the same time the hops are added; the latter impart the bitterness and flavour to the beer, and also make it lasting by removing the decomposable substances. The fluid drained off from the insoluble portions of the malt (the grains), is next passed through cooling apparatus into the fermenting cellars, where yeast is added, and fermentation allowed to proceed. The latter process, which takes place quicker or slower, according to the temperature (high or low fermentation), changes the greater part of the sugar into alcohol and carbonic acid. The prepared beer is finally separated from the barm, and filled into casks, where it undergoes an 'after fermentation.' Too extensive fermentation makes the beer sour, muddy from the presence of yeast fragments, and injurious to our digestive organs.

Among different classes of beer, distinction is chiefly made between the low fermented and the high fermented strong beer, containing carbonic acid: to the latter class belongs the Berlin pale ale. The colour of beer in general depends on the degree of heat to which the malt has been kilned: still, pale beer may be coloured brown with sugar. Moreover, the quality of the beer depends on the manner of cooling, the length of the fermentation, and especially on the composition of the "wort." The barley required

for its manufacture is partly replaced by wheat in making pale ale, but it must be employed unmixed in brewing other beers. In some places other substances such as rice, starch-sugar, &c., are used in brewing, but the addition of them to "wort" is forbidden by law in Bavaria.

The lighter German beers contain 3 to 4 per cent. export beer, 4 to 5 per cent., pale ale, $1\frac{1}{2}$ to 3 per cent. in weight of alcohol. The alcohol contained in the stronger brewed English beer (porter, ale, stout) amounts up to 8 per cent.

Beer brewed from pure ingredients is a very suitable luxury for adult persons, and on account of the carbohydrates, phosphoric salts, and other substances it contains, is not void of nutritive value. Immoderate beer drinking produces the same injuries to health as indulgence in alcoholic liquors, and promotes the formation of fat in many men. Strong brewed beer is used as an invigorating drink: thin beer (*i.e.*, poor in alcohol), and pale ale, form a refreshing beverage, and promote digestion.

§ **96. Brandy—Liqueurs.**—Instead of beer and wine, the various kinds of brandy form, in many countries, the popular stimulants among the people. In Germany, potato brandy, in particular, is extensively consumed. It is obtained by allowing the starch of potatoes that have been boiled in steam, to change into sugar by mixing it with warm water and malt: the mashed fluid is then fermented with yeast, and subjected to distillation. While the "schlempe" remains behind, the alcohol, with some impurities (fusel-oil, &c.), passes into the distilling vessel, and is either immediately put on the market as raw spirit, or is freed from its foreign elements by various refining processes, and used as refined spirit. Other brandies are produced by the fermentation of the starch of

rye, previously converted into sugar (corn brandy), or of wheat (whiskey), or of oats and maize. In France, the beetroot juice or the rich sugar—molasses, obtained from it is employed in the manufacture of the spirit. By the fermentation of various fruits and roots we get plum-brandy, cherry-brandy, gin, Hollands, and gentian brandy. Rum is obtained in the East Indies, and the Antilles by fermentation and distillation of the juice of the sugar-cane: in East Indies, and Batavia "arak" is similarly made from maize mixed with palm-juice. Of all brandies, the genuine Cognac, obtained from wine by distillation, is most highly valued.

Closely allied to brandy are the liqueurs, among which Chartreuse, Benedictine, Dantzic, "Goldwater," Curacoa, &c., are to be included. All these liquids contain, in addition to water and alcohol, smaller or larger quantities of sugar and flavouring substances, which are added partly as essential oils, partly as vegetable extracts. The so-called "bitters" are prepared without any sugar being added, from the extract of the bitter-flavoured parts of plants, along with spirit and water.

The products of distillation are generally valued more highly than the drinking-brandy prepared by extraction from plants. The percentage of alcohol in these liquids varies considerably. Ordinary German brandy contains on an average 33 per cent.; Cognac, 40 to 50 per cent.; rum, 67 to 70 per cent.; and arak about 50 per cent.

The more valuable brandies are frequently adulterated by the addition of spirits of wine or other liquids. In particular, under the name of Cognac, are sold mixtures of diluted alcohol with other sharply-flavoured liquids: *e.g.*, the absence of alcohol is concealed by the addition of the so-called "brandy-acid," which is usually an extract of

Spanish pepper. Sometimes poisonous colouring-stuffs are used to colour liqueurs, and their valuable elements are replaced by worthless and unhealthy substances.

On account of the large percentage of alcohol it contains, brandy possesses an importance for man's health very different from wine, and beer. Under certain circumstances the former stimulant is better suited than the latter for temporarily rallying the energies of a body exhausted by illness or over exertion ; moreover, many brandies (*e.g.*, good Cognac) can be beneficially administered in moderate quantity to invalids weakened by prolonged suffering. However, beverages of the brandy class lead far more easily to intoxication than beer and wine. Their natural impurities (such as aldehyde and fusel-oil), and their adulterations produce injury to health, and if taken in large quantities at once, act as a sharp and sometimes deadly poison. If brandy or liqueurs are constantly consumed immoderately for a long time, bodily and mental ruin inevitably results. The brandy-drinker loses strength, and pleasure in work, usually impoverishes himself and his family because his means of subsistence disappears, falls a prey to other passions, and becomes violent and often a criminal. Frequently he becomes in the end, a victim of delirium tremens, if other diseases have not previously worn out his body weakened by brandy. From statistics compiled in the Prussian Lunatic Asylums, it appears that among every hundred male lunatics, whose insanity was not born with them, 39 in the year 1886, 41 in 1887, and 44 in 1888, had become insane through excessive indulgence in alcohol. By an inquiry instituted in 1876 and extending to 32,837 criminals, it was found that 41·7 per cent. of the criminals were addicted to drink. In countries where drinking is repressed and punished by law, a decrease in crime has been exhibited.

§ **97. Coffee, Tea, Cocoa.**—Besides alcoholic beverages, coffee, tea, and cocoa enjoy wide popularity as stimulants. Coffee contains as its most important constituent " caffeine," tea contains " theine," similar to " caffeine," and cocoa the closely allied " theobromine." By means of these substances these stimulants act invigoratingly on the nervous system, the muscular activity, and the circulation of the blood.

Coffee is produced by the coffee tree, which is cultivated in Arabia, Persia, Brazil, Abyssinia, Java, and Sumatra. On its branches grow cherry-like berries, each of which contains as kernel, two coffee-beans. These beans are roasted, and reduced to powder by stamping or grinding; by pouring boiling water on them we prepare that hot watery infusion known as coffee, which contains as its chief elements, a volatile oil, tannic acid and "caffeine." For a cup of strong coffee about 15 grammes of coffee-beans are used, which contain on an average $\frac{1}{4}$ gramme of "caffeine;" however, all kinds of coffee do not contain the same quantity of caffeine. Many persons, for whom the use of coffee is not available, willingly drink instead, infusions of home products popular among the poorer classes on account of their cheapness, such as roasted chicory roots, beet, cereals, roasted malt, bread, figs, acorns, etc. Such substitutes, though containing large quantities of tannic acid, do not possess the same enlivening effect as coffee, on account of their lack of caffeine, they are also, unfortunately, used to adulterate the genuine coffee, especially when ground.

Tea is prepared by an infusion of boiling water on the dried and roasted leaves of the tea plant, which is especially cultivated in China, and also in India, Corea, Java, and other parts of Asia. There are two chief kinds of tea, green and black, but their peculiarities do not arise from a difference in the plant, but from the mode of their preparation.

The tea-leaves contain generally from one to two per cent. in weight of "theine," and, in addition, tannic acid and very small quantities of gluten starch, and gum. The leaves of the willow-herb, of the sloe, of the strawberry, and of the wild rose, as well as artificial colouring agents, are used in the adulteration of tea ; tea, that has been used and dried again is also sold as a counterfeit of fresh tea. In Brazil, and the neighbouring countries, "Paraguay tea" is prepared from the dried leaves of the holly or "maté" *(ilex paraguersis)*, indigenous to the country ; in its composition and effect it acts the same as the Asiatic tea. Among many nations a large number of other plants are used in the preparation of beverages resembling tea.

Cocoa is derived from the cocoa tree, a native of Central and South America, and the West Indies. The egg-shaped seeds lie in rows in the fleshy fruit, resembling our cucumbers : they are called cocoa beans, and contain about one-and-a-half per cent. of their weight of theobromine, large quantities of starch, albuminous and glutinous substances, and a fatty substance known as cocoa butter. They are freed from the fleshy parts and roasted, in which process certain substances are formed which impart the peculiar smell and taste to cocoa : they are then broken up and ground. If a part of the fat is also removed from the beans, we obtain a non-oleaginous cocoa. If the shelled beans are grounded between hot rollers the (mass thus produced, mixed with sugar and spices, and formed into tablets), we obtain chocolate. If the beans are roasted whole and crushed (often with sugar and similar substances added), cocoa-paste is the result. These preparations, when boiled in hot water, generally with milk and sugar added, yield the beverages known as cocoa and chocolate. Chocolate is also eaten without further preparation, and

is used in the making of various foods in the kitchen and by confectioners.

The starch, fat, and albumen, contained in cocoa impart to the products of the cocoa-bean, the properties of a food in addition to the qualities of a stimulant. In particular, cocoa prepared with milk and sugar can be recommended as a palatable, and at the same time nourishing beverage. Cocoa, and chocolate are preferable to tea and coffee in many respects, they are better adapted for consumption, because strong tea and coffee, if used excessively for a long time, may cause injury to the nervous system, such as headaches, palpitation of the heart, and loss of sleep.

Unfortunately, the products of the cocoa-bean are largely adulterated by worthless additions, such as animal, or vegetable fat, the flour of cereals or pulse, acorns, chestnuts, heavy spar, plaster of Paris, &c. Their value is also diminished by grinding the husks with the beans.

§ **98. Tobacco.**—Among stimulants may be included tobacco, which was originally brought from America, but is now cultivated in other parts of the globe, and thrives well in South Germany, France, Belgium, and Hungary. It is used for smoking, snuffing, and chewing.

In the manufacture of smoking tobacco, the leaves of the tobacco-plant are moistened with salt-water and laid in heaps. After a kind of fermentation has been completed in them, they are dried in order to be made into cigars, or to be rolled out as roll-tobacco, or to be cut fine. The productions of the island of Cuba are sold as the most superior tobacco under the name of Cuban or Havana tobacco. Snuff derives its sharpness and odour from repeated fermentations, often continuing for months, and from the addition of various odorous substances. Chewing tobacco consists of heavy thick leaves which are made into

rolls. Adulterations of tobacco are frequent. For this purpose the leaves of other plants, or paper coloured brown are used; or genuine tobacco is steeped in certain liquids in order to impart to it a distinct taste and odour. Among the adulteration of snuff, the intermixture of poisonous hellebore is especially reprehensible.

Nicotine forms the most important constituent of tobacco, but the quantity of it in various kinds of tobacco is very different. Taken in its purity this substance is extremely poisonous: but in tobacco smoke or in snuffing and chewing tobacco, only very small quantities of nicotine pass into the body. Its effect in the case of healthy adult men, inured to the use of tobacco, is noticeable in a gentle stimulation or soothing of the nerves, and is aided by a certain satisfaction to the eye in looking at the clouds of smoke expelled from the mouth. In the case of young persons unaccustomed to the use of tobacco, vomiting, pallor, headache, faintness, and other nervous disorders manifest themselves after using the weed. After immoderate use of it, symptoms of poisoning make their appearance. In the case of usually moderate tobacco-smokers, sickness ensues on a too excessive enjoyment of tobacco, and with persons who have for a long time indulged overmuch in this pleasure, diseases of the nervous system, and loss of vision are sometimes observed. The excessive smoking of cigarettes, prepared from strong tobacco that is rich in nicotine, is especially dangerous; in addition, the smoke of the paper is mixed with the tobacco smoke.

§ **99. Food Utensils and Vessels.**—All food and stimulants are, as a rule, palatable and beneficial to our body only when they are set before us pure and untainted. They can be wanting in these properties, as has

been pointed out in their individual treatment, if their selection, preparation, and storing is carried out in a careless or improper manner, or if they are adulterated. Moreover, it is evident that the good qualities of the victuals is injured by the use of improper utensils in their cooking and dressing, or by faulty keeping on the part of the purchaser.

The eating, drinking, and cooking utensils may be the cause of injuries to health, if the substance of which they are made contains poisonous metals, since the latter are absorbed by foods containing acids or fats. Such injuries to health are, for instance, lead-poisoning, which may arise from lead compounds used in the glazing of pottery, in the tinning of vessels or preserving tins, from the metal portions of beer, wine, and vinegar pipes, of seltzer water flasks, and children's bottles, and, lastly, from the tinfoil (which contains lead) used in packing, if these compounds pass into the food or stimulants, Even cleaning bottles with small-shot, has sometimes caused lead-poisoning, because, through inattention, single grains of shot remained behind in the bottle, and are partly dissolved in the drink afterwards poured into it.

Again, cases of poisoning have been observed after using copper, brass, or German-silver utensils (forks, knives, etc.), because verdigris had formed on them in damp air by the action of carbonic acid. If such vessels are to be used without danger, they must always be scoured clean before use, and thus freed from any verdigris that may be adhering to them. They should not be used in preparing acid foods. Boiled food should be removed from them before cooling, for the action of the air on the metal, and the passage of the poison into the food, is accomplished with great facility during cooling. The galvanising of copper and brass, and the electroplating of German-silver utensils

affords a good safeguard against poisoning, but only if the coating of tin or silver is complete and uninjured.

Zinc vessels are unsuitable for keeping milk, since, when the milk turns sour, the zinc dissolves in it, and serious digestive disorders may ensue from its use ; there is no objection, however, to the use of zinc vessels, which are well-coated inside, for the storage of water.

Iron vessels are usually provided with a coating of solder (enamelling), for, otherwise, they would impart an inky flavour, and a discoloured appearance to food stored or cooked in them. The enamel may become dangerous on its own account, through containing too large a percentage of lead.

Recently, aluminum vessels have been employed in the storage and cooking of food. The investigations as to the utility of this metal have not yet been fully completed, but hitherto no serious objections have been brought against its use.

Sometimes food utensils are painted with injurious colours ; *e.g.*, green bread, or fruit baskets are sold which contain arsenic in their colouring matter, and hence may communicate poisonous properties to the contents of the basket.

Lastly, it is to be specially noted, that eating utensils may propagate infectious diseases, if they have been used by persons afflicted with such maladies, and are subsequently used by other persons without carrying out suitable precautions beforehand. If such vessels after use by the sick, are boiled for some time, or are thoroughly disinfected in a manner to be decided by the doctor, they lose their dangerous qualities. Moreover, all vessels used in storing or cooking food or stimulants must be first cleansed, since the impurities adhering to them—dust, particles, etc., may easily contain injurious substances.

§ **100. Storage of Food.**—The storage-room for

food and stimulants should be dry, airy, and of uniform temperature—*i.e.*, it should be safeguarded from frost. Meat and meat-foods are best hung freely, so that the single pieces do not touch one another. Bulbous growths may be kept in quantities in pits filled with straw, or in chests filled with sand. In storing potatoes it should be noted, that the decayed ones should be at once removed, or the whole supply will become bad.

The ingress of insects is prevented by meat safes, or bell-shaped wire grating. Larger pieces of meat, hams, etc., may be protected by covering them with linen bags. Ice safes must be carefully scoured from time to time with hot water and soda, since, otherwise, food stored in them acquires an unpleasant flavour. Strong-smelling viands, as cheese, etc., are kept apart from such victuals as absorb odorous particles. In general, in storing we must carefully avoid everything that can injure flavour, for a flavour stimulating to the appetite, is necessary for digestion, and hence is beneficial to the body from the point of view of health.

IV.—Clothing.

§ **101. Clothing as a Protection Against Cooling.**—The human body constantly gives off quantities of heat to the surrounding atmosphere, which quantities are greater the lower the temperature of the air. The clothing offers a protection against the cooling thus caused, which is especially perceptible in temperate and cold climates. Various materials are employed in its manufacture, which are derived partly from the animal kingdom, as furs, leather, wool, feathers, horsehair, and silk ; partly from the vegetable kingdom, as linen, cotton, and india-rubber. The protection afforded to the body by such materials depends

on their thickness, and their heat-conducting power. Materials which conduct heat badly—that is, slowly absorb and slowly diffuse it, best counteract the effects of cold. However, it is not a matter of indifference, whether the body is surrounded by a single layer of clothing, or with several superimposed garments. For the air present between the separate layers of clothing acts the same as a bad heat conductor, separates the skin from the colder atmosphere around it and does not permit an immediate interchange of heat between them. For the same reason, porous fabrics, on account of the air enclosed in their pores, contribute more to the preservation of the heat of the body than thick materials. This explains, that the hands and feet easily become cold in winter when enclosed in tight leathern gloves or boots, which do not permit the formation of a warm layer of air between the skin and these articles of clothing. Polar animals are especially fitted for enduring severe cold, because they carry with them a thick layer of air on the surface of their bodies—the mammals in their furs, the birds in their feathers—and they are able to temporarily increase its volume by bristling their hairs or ruffling their feathers. Of the materials used for clothing, woollen stuffs afford a more effective protection against cold on account of their greater porosity, than materials made from cotton, linen, and silk; the spongy, rough chamois keeps us warmer than smooth patent leather; furs are more beneficial in proportion to the length and thickness of the hairs. All these materials lose this capacity for maintaining the heat of the body by storing up an envelope of air, if they are denuded of their hair or pile by much wear, or if, by taking up dirt or dust, they become less capable of storing air. Even the dying of clothing materials may injure their cold-resisting capacity if the pores in the fabric are lessened in size by the colouring stuff.

§ **102. Clothing as a protection against damp.**—Besides their capacity for containing air, many clothing materials are also capable of retaining moisture in their fibres and pores. They thus prevent rain from penetrating to the skin, absorb the aqueous vapour from the atmosphere, and the perspiration of the body, and in this way protect the surface of the body from dampness.

However, this advantage only lasts until a certain degree of saturation of the material is attained. Moisture, which exceeds this degree, overflows the pores and imparts a damp character to the material, which produces uncomfortable sensations on the surface of the skin. At the same time the evaporation of the surplus moisture causes a cooling, which is felt to be equally unpleasant, and affords an occasion for colds.

Among our clothing materials, wool absorbs moisture more slowly than cotton, silk, or linen ; moreover, the last named materials are very soon saturated with moisture, whilst the absorbent capacity of wool is far less limited. Furthermore, silk, linen and cotton possess the unpleasant property of lying close to skin when damp or wet, thereby producing the sensation of dampness on the surface of the body, and favouring our catching cold , on the contrary wool, thanks to the elastic filaments which give it its rough appearance, lies even further from the skin when thoroughly saturated, and allows a layer of air to continue as a safeguard against cold and damp. On the other hand wool, as a clothing material is not lacking in certain injurious qualities ; under certain conditions it promotes excessive perspiration, which is weakening to the body, it delays the evaporation of perspiration, and admits of a refreshing coolness in summer, less than other materials The body too little unaccustomed to the influence of cold, through continuous wearing of woollen clothing, accordingly

loses part of its capacity for withstanding colds. Again, as wool is relatively dear, easily wears out in washing, and by the reception of dust and dirt acquires an untidy appearance more slowly than other materials, it is, therefore usually cleaned less frequently than others. Hence, woollen garments often contain large quantities of dirt, these not only lessen its capacity for absorbing air and water by filling up the pores of the material, but may also cause direct injury to health. Lastly, it must be mentioned that woollen underclothing frequently causes severe irritation of the skin in persons not accustomed to it.

§ **103**. **Selection of Clothing Material**.—There is no clothing material which ought to be preferred to others in every respect. Hence, in our choice we must pay attention to the season of the year, the conditions of the weather, and the occupation and state of health of the person to be clothed ; moreover, materials for underclothing are to be selected differently than those for outerclothing. In general, wool is to be preferred, if it is intended to protect the body against frost, sudden cooling, or wetting, while other materials may be freely selected as light clothing in warm dry seasons of the year. Persons, who in consequence of their occupation, expose their bodies to the influence of the weather, or become heated through muscular exertion, and must then expose themselves to sudden cooling, *e.g.*, masons, sailors, pedestrians, should wear woollen underclothing ; still in summer they ought not wear too thick materials, because the accumulation of heat produced by muscular labour becomes dangerous by prolonged hinderance of cooling,—for instance it may lead to sunstroke. Woollen underclothing is especially suitable for persons who are disposed to colds, particularly to effections of the throat, rheumatism of the joints and muscles.

Linen or cotton underclothing is recommended in occu-

pations which do not require any considerable muscular effort, and are carried on in apartments of a constant temperature. One advantage of such clothing is its lightness, and its pleasant qualities after repeated washings.

The choice of materials for outer garments is almost exclusively regulated by the season of the year, and the weather. In winter thick woollen stuffs are worn, in severe cold, furs; in summer garments of linen, cotton, and silk. Woollen materials which have been made waterproof by particular processes (*i.e.* whose fibre have been deprived of their power of absorbing water) protect the body best from wetting. These have the advantage over the india-rubber materials used for the same purpose that they are pervious to air, and hence allow evaporation of the moisture of the skin, without which unhealthy disorders of its functions may easily ensue.

§ **104. Colour, Shape, and Mode of fastening Garments.**—The colour of garments is not unimportant; for dark materials absorb the warm rays of the sun better than bright, and hence the former easily become warm in summer, and are to be preferred for winter use, while the latter are justly recommended for warm weather. We should also assure ourselves, that no poisonous colours have been employed in dying the materials selected.

The manner in which the clothing is worn is likewise not unimportant in regard to health.

Our garments should neither interfere with the free movement of the body and its limbs, nor with breathing, digestion, or the circulation of the blood. Oppressively tight fitting garments are to be avoided, because they interfere with circulation, as well as with the function of the skin by compressing the skin glands, and they do not permit of the

formation of a layer of air between the skin and the garment.

§ **105. Clothing for the Neck.**—By tight clothing around the neck obstacles are placed in the way of our breathing, and to the reflux of the blood from the head and brain; which may give rise to choking, to congestion of the brain, headache and swooning. On the other hand loose clothing around the neck assists the excretions from the skin with advantage, since it favours an interchange between the outer air, and the air under the garments of the trunk. Hardy persons, *e.g.*, sailors, dispense without injury with any covering for the neck; anyone however less inured to the influence of the weather does well to protect the neck against sudden cooling by suitable covering. Young and healthy persons are to be warned against effeminacy, through wearing thick mufflers, fur tippets, and similar articles.

§ **106. Constriction of the body by the Clothing, or the manner of fastening it.**—The fastening of the trousers by a belt prevents the movements of the intestines necessary for digestion, and may contribute to the formation of what are called abdominal ruptures. These begin gradually when the intestines (on drawing a deep breath or coughing another point of expansion becomes impossible or difficult), force their way outwards by degrees from the abdomen as far as the skin, between the muscular fibres and the sinews usually in the neighbourhood of the pelvis or close beneath it near the upper thigh. In exceptional cases sudden violent shocks to the abdomen (*e.g.* in jumping) can be the cause of rupture. Such is in itself a troublesome malady, and can, moreover occasion digestive disorders and severe indispositions, in case they are not confined by a suitable appliance.

The improper use of corsets by women, who believe they are beautifying their form by tight lacing, causes injuries to their health. For tight lacing injuriously affects not only breathing and digestion, but also leads to disturbances of the circulation, to changes in the position, to malformations of the inner organs, and to deformities of the bones. (Fig. 29).

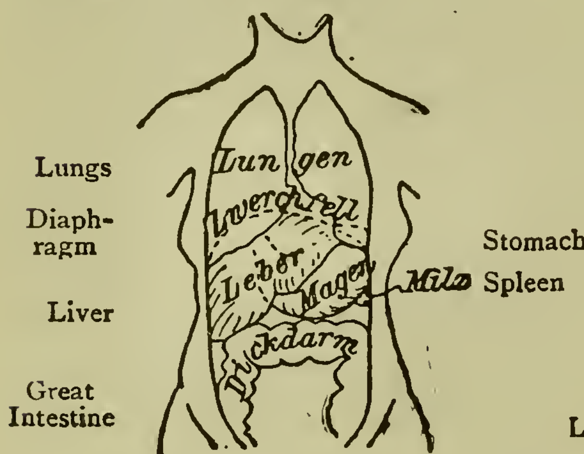


Fig. 29.
Position of the Thoracic and Abdominal Viscera in the natural formation of the Thorax.

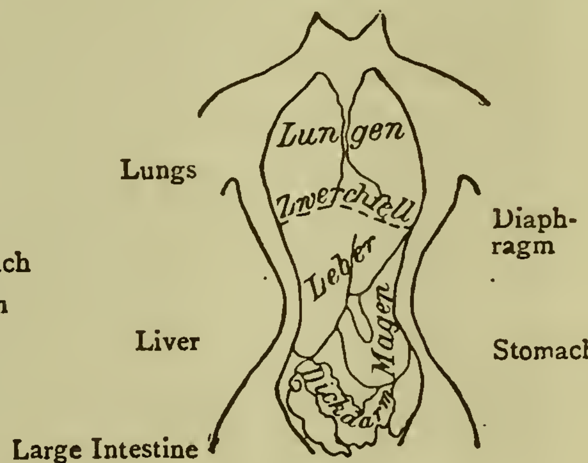


Fig 30
Position of the Thoracic and Abdominal Viscera in malformation of the Thorax through tight lacing.

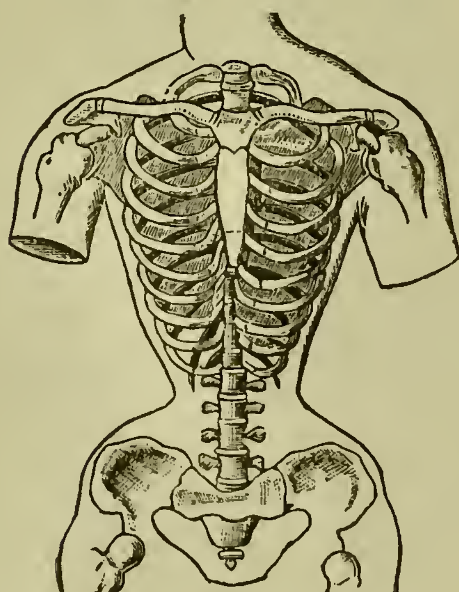


Fig. 31.
Malformation of the Thorax through tight lacing.

Fig. 32.
Malformation of the Foot in a pointed Shoe (A).

§ **107. Garters, and Coverings for the Feet.**—Tight garters prevent the circulation of the blood in the veins of the lower leg and foot, and so contribute to

confine the blood to these limbs and to the swelling of these blood-vessels, sometimes even so far, as to burst the veins and cause dangerous bleeding. In the neighbourhood of such swollen veins are often formed painful ulcers difficult to heal. It is, therefore, advisable not to fasten long stockings by garters but by means of elastic strings connected with the upper garments.

Particular attention must be paid to comfortably fitting boots, which correspond to the natural shape of the foot. The shoe or boot should grasp the instep firmly, and not contract the heel too much, and leave sufficient space for free play of the toes, which at every step move forwards by the flattening of the arch of the foot beneath the weight of the body. In consequence of the different shape of the two feet the inner soles should not be creased, and should be kept carefully clean on account of the frequent and vigorous action of the skin of the feet. High heels render both walking and standing, difficult, as the elevation of the heels occasion an uneven exertion of the sinews of the flexor and extensor muscles, and thereby easily tiring the muscles of the lower leg, creating moreover a disproportionate distribution of the weight upon the foot, inasmuch, as that portion of the weight of the body, which under ordinary circumstances rests on the heels, is thrown too much on the ball of the foot. A pointed shoe contracts the toes, thereby occasioning a mal-formation of the foot (see Fig. 32), and promoting ingrowing toe-nails. The pressure of badly made shoes causes painful swellings, such as corns blisters, and bunions.

All these evils occasioned by defective shoes, even though they appear trifling in themselves, lead to this, that they prevent the persons afflicted with them from taking part in those exercises in the open air which health requires. If the feet are not washed frequently and carefully,

painful inflammations may arise through the penetration of dirt into the sore spots, which may have serious consequences in regard to the utility of the feet, or the life of the individual. For the avoidance of such dangers, cleanliness is imperative for those whose feet perspire freely Perspiration of the feet promotes the accumulation of dirt, causes skin abrasions, by means of the chemical decomposition that results therefrom, and which is easily perceived by its repulsive smell, and which is the source of various diseases of the feet.

§ **108. Head Gear.**—A heavy or unsuitable covering for the head causes a feeling of oppression, giddiness, headache, and contributes also to baldness, more especially when it disturbs the airing of the skin of the head so covered, by obstructing the free passage of air. The head gear should therefore be light, should not press heavily on any part, and should either be made of porous material, or be provided with ventilating holes. In order to afford protection to the head and neck against rain, and the rays of the sun, a broad brim is advantageous.

§ **109. Bedding.**—At night time whilst the clothing worn during the day-time is laid aside and exchanged for light night garments, the bed affords protection against a chill. On account of the proportionately smaller capacity of the body for evolving heat when at rest, thicker materials are selected for bed-covering, than for clothing. For healthy adults woollen or thinly lined counterpanes, are however sufficient as bed-covering, and for ticking mattresses full of pine shavings, or horse hair, or well stuffed with straw. Thick feather beds render the passage of air between the surface of the skin and its surroundings difficult, and especially so if they are used as ticking they tend to make the body effeminate. Eiderdown and similar quilts

can be recommended only for children, old men, and invalids for whom a large amount of warmth is indispensable. For the sake of cleanliness counterpanes and sheets of linen or cotton are used, which may be easily washed and exchanged. By means of constant shaking and airing the bedding should be freed from the dust particles and skin-excreta which accumulate. The frame of the bed, in order to render the access of air easy, must be raised from the ground, and is likewise to be kept carefully free from dirt.

§ **110. Cleanliness of Clothing and Bedding.**—The cleanliness of clothing and bedding is of immense importance for the preservation of health. As dirt prevents the access of air, causes foul odours by decomposition, and readily aids the germination of diseases, it should be removed from our clothing with the same care as from the skin itself. Therefore, under-clothing should be frequently and thoroughly washed, and the outer garments should be daily brushed and shaken. Hence the garments of others should never be worn without a previous careful cleaning, and bedding and linen of others should never be used without a previous thorough washing.

V.—The Dwelling.

§ **111. Purpose of the Dwelling.**—In addition to clothing, the dwelling serves to protect us against the severity of the weather. It not only affords us a refuge from rain, wind, and cold, but it is also a focus of family life, whose successful development forms the most reliable basis for the health of the people, and for a vigorous and

orderly community. Hence the attainment of healthy and comfortable dwellings is one of the most important duties of a sanitary authority.

A healthy and comfortable dwelling should be roomy, bright, warm, and dry, and should neither harbour foul air, dirt, nor disease germs. The fulfilment of these conditions depends upon the building ground, position, building materials, roofing, interior structure, utilisation of the dwelling rooms, the arrangements for ventilation, heating, lighting, and removal of refuse, and lastly on the care and cleanliness of the inhabitants.

§ **112. Sub-soil and Site of the House.**—The sub-soil of a dwelling-house should be dry and free from decomposing substances, so that the moisture and unhealthy exhalations from the earth, may not penetrate into it. A clean, firm, sandy soil, on a somewhat elevated position, favourable to drainage, forms a suitable building site. If water is met with at a small depth, it is imperative to drain it off by pipes. Where this is not possible, it is advisable to line the foundation walls and basement of the building, with suitable materials, such as asphalte and concrete, or to keep the water at a distance by what are known as isolating walls.

Such protecting walls for keeping the cellars dry, must be constructed of the most impenetrable stones and cement mortar. They must penetrate deeper than the foundations of the house, and be separated from them by a layer of air several centimetres thick.

If the subsoil is polluted, it is dug out to a considerable depth, and replaced by good sand. Filling up building-ground with refuse and dirt is most objectionable.

The ingress of light and air must not be prevented by the position of the house.

Hence, a dwelling-house open on all sides is generally

preferable to a house built in a narrow street, even if a position, protected against cold north winds and keen east winds, offers other indisputable advantages.

§ **113. Building Material.**—As building materials for houses, we use wood, natural stones (especially sandstone, limestone, marble and granite), or bricks formed of burnt clay. As cement for binding stones we generally employ mortar, a substance composed of dissolved lime sand, and water, which quickly solidifies, and should dry in a short time.

In judging building material from the standpoint of Hygiene, its porosity and dryness afford a standard for our guidance. By means of the pores of the walls a certain interchange takes place between the air of the house and the outer air. This so-called natural ventilation which proceeds without artificial means, such as the opening of doors, windows, or ventilators, supplies the occupiers with a portion of their air. Hence very porous building materials are to be preferred, especially because porous walls in summer protect the house from the direct summer heat, and in cold seasons best keep it warm; for the air enclosed in the pores prevents the same temperature existing inside and outside the house in the same way as porous garments protect the body from chill (*cf.* paragraph 101). Of the building materials mentioned, limestone, wood, mortar, brick, and sandstone possess more or less sufficient number of pores, and on the contrary, marble and granite have few pores, which explains why a wall constructed of the latter stones always feels cold, unless directly heated by the sun.

Hence the first-named materials are preferred for the walls of dwelling-houses, whilst marble and granite are most employed for ornamental structures, memorials, etc.

Besides the porosity, the dryness of the building

material guarantees the healthy character of the house. Moisture closes the pores, and thus lessens the quantity of air contained in the walls, and reduces their heat-retaining capacity ; at the same time, its inevitable evaporation contributes to further cooling. Hence, a damp wall constantly feels cold, and cold air usually emanates from new buildings which are not yet dried. Moreover, moisture favours the development of various classes of fungi, *e.g.*, dry rot, whereby the durability of wood-work is endangered, damp air is produced in the house, and a mouldy smell generated. Such fungus growths, also pass-over to house utensils, bread and other victuals and destroy them, and it is not improbable that many illnesses find their origin and development in damp walls.

§ **114. Drainage and Drying of House.**—The healthy dryness of a house depends not merely on the quality of the building ground and materials, but essentially on the certainty and thoroughness with which the drying of the rough structure is effected. Before a building can be regarded as in any degree dry, the greater part of the water introduced into the walls along with the mortar—the quantity of which is estimated at about 85,000 litres for a medium-sized town dwelling-house—must be evaporated.

This process is effected most quickly by a powerful draught of air, and is aided in cold or damp weather by fires, and opening the windows. Only when the drying has progressed sufficiently should the shell of the house be plastered, and further finished. Even a completed house requires thorough airing and drying, before it can be inhabited without danger to health.

The walls of the house are protected against injurious soaking from rain, etc., by plastering and painting, whereby the building at the same time acquires a more pleasing

exterior. Lime is used for plastering dwelling-rooms Plaster of paris is used for stucco work, and combined with soluble glass for manufacturing external waterproof-linings, cornices, etc. For this purpose whitewash offers least resistance, and oil colors the greatest resistance to the ingress of water. All these colorings of the walls gradually succumb to the weather, become moist and penetrable to water ; hence they require renewing from time to time.

The dryness of a house is in a great measure ensured by a good roof. Rain and snow water should nowhere find apertures in the roofing, but should be able to flow freely over it and be quickly and completely carried off by gutters. As materials for roofs in houses, the garrets of which are to be inhabited, tiles are especially suitable; for tiled roofs which are laid upon rafters and joists, and are provided with a sufficient number of shuttered openings to ensure a thorough ventilation of the lofts, are the surest protection against dampness and cold. On the other hand, apartments under metal roofs frequently are both close in summer, and hard to heat in winter. Roofs consisting of a frame-work of wood, upon which a layer of tarred felt, or thick cement, is spread, are recommended on account of their cheapness.

§ **115. Structure of the House—Floors and Walls.**—In order to maintain a sufficient intervening stratum between the floor of an upper and the ceiling of a lower room, so as to deaden the sound, as also to promote the preservation of heat, it is usual to fill up this space with the lightest, but most porous, dryest, and at the same time cheapest material. If such filling material is contaminated with vegetable or animal debris, it may become the seat of foul-smelling decompositions which allow repulsive and unhealthy odours to penetrate into the dwelling-rooms ; hence the use of polluted filling-

up material, especially the building rubbish so freely used in former times, is to be deprecated.

Clean dry sand, coke-cinders, scoriæ peat-lime are suitable; still, even with these, decomposable and putrid substances may penetrate through the joinings and cracks of the boards along with the sweepings, the scouring-water and the dirt from boots, if sufficient care is not devoted to the caulking of the floor. Where similar maladies regularly re-appear in the same apartment during a long period of time, we must reflect on the possibility that the germs of the disease have settled in the under floor, and can only be got rid of by renewing this.

Wood is preferred as flooring for dwelling-rooms as it keeps them warm better than a stone floor; it is used chiefly in the form of flooring boards, or parguetry. A coating of paint or wax increases the durability of wood-flooring and facilitates its cleaning. Stone, cement and asphalt are more suitable for the floors of rooms especially exposed to damp, *e.g.*, bathrooms or laundries. If the floor of cellars are formed of these materials, it is usual to lay a wood-floor over them, but so that a layer of air remains between the two floors, which keeps the cellar warmer and protects it from foul air.

In order to preserve the floor from dirt, as well as to deaden noise and increase the warmth and comfort of the apartment, it is usually covered with thick impenetrable stuffs, *e.g.*, carpets of all kinds or linoleum, manufactured from corks. Carpets require to be frequently and thoroughly shaken, as they usually take up large quantities of dust, which may contain dangerous germs. Carpets should be entirely removed from sick-rooms, because infectious germs adhere to them, and are spread by them.

Wall paper is usually found as a covering for the walls of dwelling-rooms instead of whitewash or paint, and no

objection can be made to its use; it gives the room a cheerful appearance, and protects the walls from damp and dust. On the other hand, wall paper prepared from heavy materials is a great absorber of dust, and can be cleaned only with great difficulty. The health of the occupiers of rooms may be seriously endangered by wall-paper coloured with poisonous substances, *e.g.*, arsenic.

§ **116. Utilisation of dwelling-rooms—Air-space—Plan of the dwelling.**—Besides the character and structure of dwelling-rooms, the manner of their utilisation is important for the health of the occupiers. The living of many persons in a narrow space injures the purity of the air, leads to the accumulation of dust and dirt, and promotes the spread of infectious diseases. A dwelling that will answer the requirements of hygiene, must, therefore, possess a certain spaciousness. Little value was formerly attached to this, and only in recent times has the necessity of providing a definite amount of air-space for each occupier, been recognized. As many spacious apartments, especially in old houses, are insufficient for the air-requirements of the occupiers on account of their low ceilings, the Berlin building regulations prohibit the construction of dwelling-rooms with a smaller height than 2½ metres. On the other hand the economy of space in private dwellings over-steps frequently the bounds permitted by hygienic considerations, and the air-space of 15 to 16 cubic metres allowed to every German soldier in his barrack-room, is not at the disposal of many occupiers of private houses.

Unfortunately, economy compels many people to combine in one, bedroom, workroom, dwelling-room, and kitchen. In such cases the occupiers, as a safeguard for their health, should not neglect to, at least, air and clean the room as often as possible. Whoever is in a position to choose a larger dwelling, should strictly maintain a division

between the dwelling-rooms, and those devoted to other purposes: in particular, large, bright, and airy apartments should be devoted to bedrooms, and workrooms, in which relatively the largest portion of the twenty-four hours is daily spent.

§ **117. Ventilation.**—The air necessary for human beings inside a house, is not fully provided by sufficiently spacious rooms: there is required, in addition, a constant renewal of the air, rendered impure by breathing and perspiration, in close inhabited apartments. The usual fresh appearance of country people occupied in the open air, as opposed to the ordinarily pale complexion of towns-people who spend the greater part of the day in closed rooms, is a notable proof of the beneficial effect of pure air on health. Moreover, the results of a defective air-supply may be frequently noticed in the fainting of weakly persons in churches, assembly-rooms, and theatres.

The change of air necessary in houses is supplied to a certain degree by natural ventilation (§ 113), but by far the largest part of the air required by the occupiers, must be provided by artificial ventilation.

The simplest contrivances for this purpose are sufficiently large doors and windows, provided with dash-boards, and ventilating panes. The regular opening of the latter preserves the air-supply with most certainty: however, in rooms occupied by several persons at the same time, this process is generally displeasing to some, and is therefore often neglected, through exaggerated precautions against draughts. In addition, in many houses there are air passages leading from the outer walls of the house into the rooms, and opening, some just above the floor, and some close under the ceiling, so as to bring in the pure air below, and carry off the foul air at the top. The so-called "ventilator-wheels," which force the air into such

passages and exhaust it from them, are used for the same purpose. Lastly, the chimneys of the house are fitted with special caps (Fig. 33), so that the wind blowing through them draws up and carries away the foul air. During winter, the supply of fresh air is further assisted by the heating apparatus.

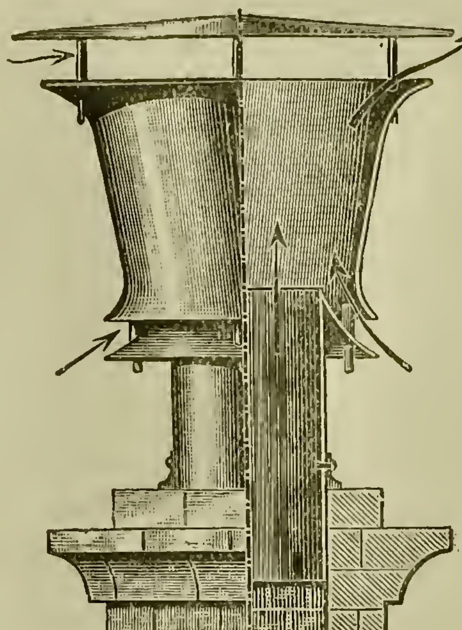


Fig. 33.
Chimney Cap for Ventilation (after Wolpert).

§ 118. Purpose of Heating.—Requisites of a Heating Apparatus.— The protection afforded to the house by walls, floor, and roof is not sufficient in cold seasons to preserve the air in the house from becoming chilly, and the occupiers from the effects of frost. Hence, we try by heating the house to replace the warmth withdrawn from it by the winter-cold : this is done partly by directly heating the air of the room by burning combustibles, partly by introducing hot air, steam, or water into the room.

The results of heating are effectively aided by stout walls that conduct heat badly (§ 113), as well as by tightly-closing doors, and windows, and particularly by double windows. The quantity of heat diffused by various kinds of fuel is different : the heat arising from the combustion of coal, is four times as great as that produced by burning wood, and between coal and wood, anthracite-coal, coke, charcoal, pit-coal, and turf may be arranged in a series of descending value as heat-agents.

The complete utilisation of the heat produced by the fuel depends essentially on the heating apparatus, since the

latter may not only render the success of the heating doubtful, but also bring with it unhealthy consequences. A serviceable heating apparatus must give out sufficient heat in seasons of severe cold, and still must admit of being regulated so as never to overheat rooms requiring warmth. Moreover, it should diffuse its heat uniformly, and not produce the state of things so frequently observed—viz., that the floor remains cold while the upper strata of the air in the heated room are excessively hot. The fuel must be consumed as completely as possible in the heating apparatus, without leaving behind large quantities of ashes; the smoke and gases of combustion should not penetrate into the room, but have a good draught to carry them off. The air in the house should always possess a certain degree of moisture, and hence should not be dried up too much by heating: finally, risks arising from the use of the heating apparatus must be completely excluded.

The injuries to health arising from defective heating arrangements are manifold. Colds and chills, etc., frequently occur among the occupiers of unequally-heated houses; smoke in the room causes irritation in the tissues of the eyes, and headache: the gases of combustion (particularly the dreaded fire-damp, whose most dangerous constituent is carbonic oxide gas), frequently produce fatal poisoning.

§ **119. Fireplaces and Stoves.**—We may distinguish between apparatus for heating a single room, and contrivances for heating an entire building (single, and collective heating).

The simplest arrangement for heating a single room is the fireplace (Fig. 34), which dispenses warmth of an open fire directly to the room to be heated, and carries off the gases of combustion up the flue without the aid of a special chimney. As heating by means of fireplaces requires a

relatively large quantity of fuel, only heats the room sufficiently in the immediate neighbourhood of the fire, and does not prevent the smoke returning into the room when the wind blows strong enough from certain directions, heating by stoves is almost universally preferred in Germany. In these, the heat of the fuel is first communicated to the heating surface—*i.e.*, the sides of the stove, and from these is distributed to the air of the room to be heated. The ashes of the burnt fuel fall from the fireplace through a grating into the ash-box, smoke and the gases of combustion escape through the stove pipe into the flue.

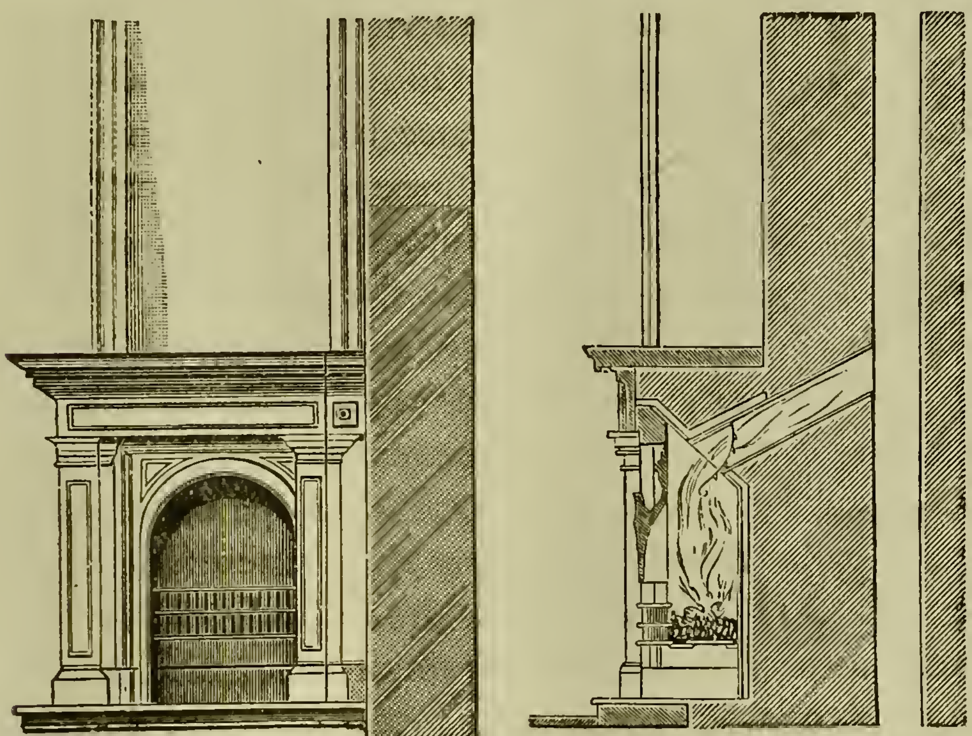


Fig. 34.
Fireplace in Front and in Vertical Section.

The value of a stove depends on its capacity for utilising the heat of combustion. The more completely this is distributed to the heating surface and the longer it is retained by the latter, the greater is the heating power of the stove.

The simplest stove is the so-called "cannon stove"

(Fig. 35) whose heating surface consists of a simple iron pipe resembling a cannon. This class of stove heats itself, and the surrounding air quickly, but cools just as quickly if the fire gets low, and therefore requires constant feeding with fuel. Moreover, it easily gives off a burning smell, as the red hot iron pipe burns up the dust deposited on it from the surrounding air; besides the heat in its immediate neighbourhood is often unendurable, and, lastly, the flue is usually not closely jointed so as to prevent the appearance of smoke in the room.

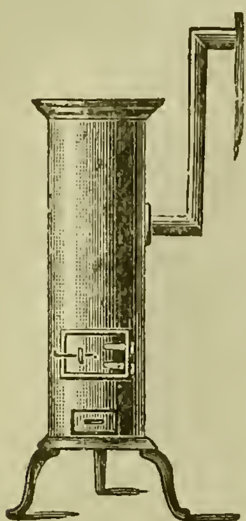


Fig. 35.
Cannon Stove.

The last-described evil is particularly dangerous to life when stove-dampers were used: hence for some years in many towns, stove-dampers have been removed by the public authorities. The closing of a damper placed in the stove-pipe just before its opening into the flue, should prevent any escape of the heat of the stove: however, it frequently forces the gases of combustion to find a passage into the room. Thus the above mentioned carbonic oxide gas (§ 118) passes into the air of the room: this gas acts as a poison even in small quantities, and is all the more dangerous because its presence is not detected by any peculiar smell.

§ **120. Filled Stoves, Hooded Stoves.**—Efforts have been made to remove the defects of the cannon stove by improvements. Thus the filled stove (Fig. 36) was devised, wherein the fuel for six, twelve, even twenty-four hours is placed at the same time: in this way it gives out heat uninterruptedly for a long time without needing refilling. The heat diffused by it can be increased, or lessened, by opening more or less, a door placed at the foot

of the stove. By means of the hooded stove (Fig. 37) a uniform distribution of heat in the room is attained. The hood (in iron stoves it consists of a cylinder of tin) surrounds the stove in such a fashion that a free space a few centimetres wide, remains between the two, both above and below. The air in this space first becomes heated by the heating surface of the stove, and therefore, lighter than the air in the room; consequently it mounts upwards and issues from the top of the hood, while fresh air

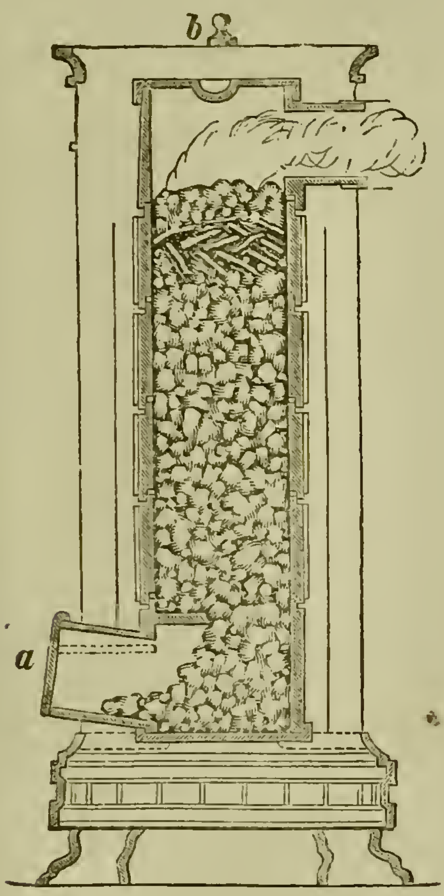


Fig. 36. Charged Stove.
At *a*. Door for Regulating Air-Draught. *b*. Aperture closed by a cover for adding additional Fuel.

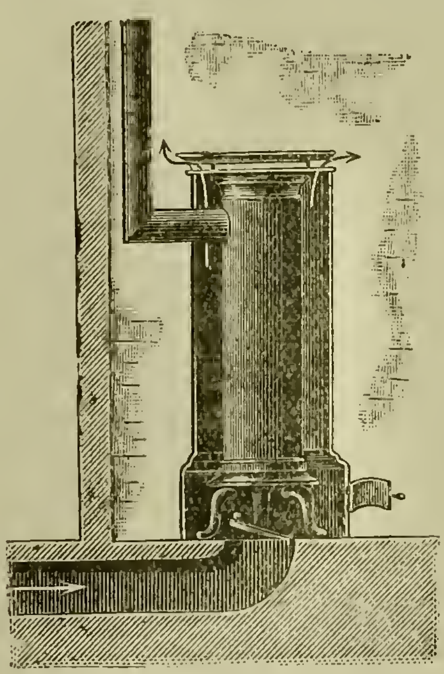


Fig. 37.
Mantle Stove.

enters below, is heated in its turn and carried out at the top. This circulation of the air in the room through the hooded space (which has gained for these stoves the name of "circulation-stoves"), on the one hand renders possible the uniform heating of a large room, and, on the other, prevents over-heating of the portion of the room lying nearest to the stove. If a pipe provided with a movable damper, is carried from the hooded space

through the wall to the outer air, we can by closing or opening the damper, allow only the air in the room to circulate through the hooded space or conduct outer into the latter—that is, supply fresh air as well as heat, to the room. By such an arrangement the stove becomes a ventilating stove, serving for ventilation as well as heating. By placing a basin full of water near it we can counteract the drying of the air caused by the heat.

§ **121. Earthenware Stoves.**—Metal stoves have the disadvantage that their heating surfaces lose their heat as quickly as they acquire it, and hence require constant

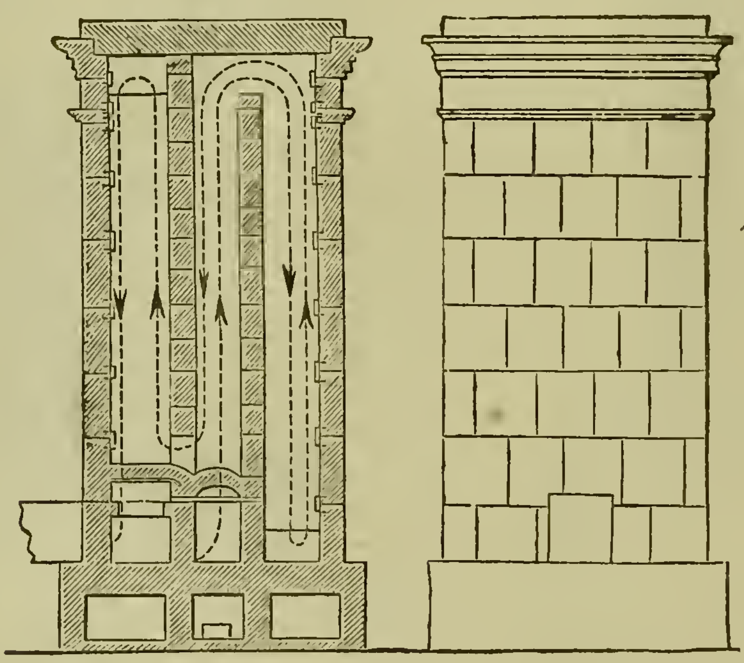


Fig. 38. Dutch Oven.
In Section in front.

renewing. The waste of fuel thus caused is obviated successfully in the full stove by the regulation of the air supply, since the rapidity of combustion is reduced without interrupting the heating process. Still, the earthenware stove is much more commonly used in Germany than the "full stove"; in this (Fig. 38), earthenware which is a

worse heat-conductor than metal, takes the place of the latter as the heating-surface. Most earthenware stoves are, in a sense, hooded stoves, for the heating-surface is usually arranged in several coils (shelves) in order that the gases of combustion may impart their heat as completely as possible to the stove, before passing into the flue. As an earthenware stove heats, and looses its heat slowly, a longer period of time elapses after its being unlit till the room is heated, than in the case of a metal stove.

§ **122. Collective heating by Air, Water, or Steam.**—The inconvenience of heating single rooms, inseparable from attending to numerous stoves in the same house, is avoided by collective heating. In this process a large stove situated on the ground-floor forms a source of heat for the entire house. From a hot-air chamber, or a boiler, heat is conveyed to all the rooms of the house by means of pipes full of hot air, hot water, or steam. While the hot-air pipes open freely in each room,* and distribute the hot air directly to each, the water or steam remains in the pipes, which are arranged in numerous coils in order to increase the heating surface, until reconveyed back to the boiler.

Collective heating has one advantage—viz., the supply of heat to each room may be regulated as required ; in the case of hot-air pipes by valves, and in hot water or steam pipes by cocks. An apparatus of this kind may be easily combined with ventilating arrangements, especially in the case of heating by air, for the air supply for the heating chamber may be drawn direct from the outer air. On the other hand, any disarrangement in a system of collective heating is very unpleasantly felt, because it is perceptible in all the rooms connected with the system. Hot water and steam, sometimes produce unpleasant noises in the pipes, and do not always afford

sufficient heat; steam-pipes are always exposed to the danger of explosion through faulty laying, or carelessness in their management. Hot air pipes must be carefully kept free from dust in their interior, otherwise they contain charred dust that fills the room with an unpleasant odour, and produces a troublesome feeling of dryness of the mucous membrane of the respiratory organs. It is always desirable to mix some steam with the hot air, before it is conducted into the room.

§ **123. Protection of the house from Heat.**—By a properly arranged system of heating it is not difficult to maintain a comfortable temperature of about 18°C. in the dwelling-rooms during the cold seasons. Experience proves this temperature to be the most conducive to health, as it neither relaxes the body, nor does it produce, as if the temperature is raised, an unpleasant feeling of a rush of blood to the head.

It is considerably more difficult to protect the dwelling-rooms from excessive heat in summer, which reduces the elasticity and working power of the body. Thick walls are most to be relied on for keeping the house cool. Where these cannot be constructed, it is well to procure a layer of air inside the wall by using hollow bricks, as on the one hand, air conducts the heat of the sun's rays absorbed by the outer wall of the house more slowly than stone, and on the other, as soon as it has become hot it ascends and conducts a part of the heat away from the house, when suitable modes of egress are provided in the wall. Even the colour of a house is not unimportant in regard to its coolness, as the heat of the sun's rays is reflected from bright, and is absorbed by dark walls. Metal roofs become hot quicker, and are better heat conductors than roofs of tiles, wood or straw. The rooms themselves are protected from the immediate effect of the sun's rays by window-

curtains, &c. Good ventilating arrangements contribute largely to cooling the house, especially if the fresh air is obtained from the shady side of the building.

§ **124. Brightness—Natural Lighting.**—Protection from the sun's rays is a great benefit to a house, but it is a still greater disadvantage if the access of the sun's light to the rooms is intercepted. All people long for light, the healthy pursue their labour more vigorously and cheerfully in a bright room, the invalid has his bed drawn to the window of the sick room, in order to rejoice in the daylight. Light, which illuminates the most out-of-the-way corners of a room, impels us to cleanliness, and destroys immediately many of those micro-organisms which are the cause of decomposition and disease. On the other hand dust and dirt easily accumulate in dark rooms. Defective lighting depresses the mind, compels us to strain our eyes, and gradually injures our power of vision. Hence the house should be open to daylight as much, and as long as possible, even if it is advisible to cover the windows temporarily as long as they are exposed to too glaring light from the rays of the summer sun.

To light a room sufficiently, it is enough, if the total window-space amounts to one-fifth or one-sixth of the floor area of the room, as a wall in front of the windows diminishes the supply of light, the distance between the house and the wall should be at least equal to the height of the latter. The lighting is improved by bright wall paint, and light wall-paper inside the room itself.

§ **125. Artificial Lighting—Wax Candles, Oil and Petroleum Lamps.**—Insufficiently lighted rooms require artificial lighting, by illuminating power, either of flames or of red heat. That class of lighting is

most valuable, which comes as near as possible to the sun's light, in strength, colour, and uniformity, which does not produce much heat, is unattended with any danger of explosion, and distributes least impurity to the air.

Candles manufactured from tallow, wax, stearine, or parafin, afford an easy-flickering light, less endurable to the eye, on account of the large admixture of yellow rays; this light is not now considered sufficient to work by. Candles have the further disadvantage of giving off relatively large quantities of soot, and of diffusing noxious gases of combustion in the air of the room.

Lighting by means of lamps is more advantageous, in them various oily liquids are used as fuel for the flame. The essential parts of a modern lamp are, (1) the bowl for the oil or other liquid to be burned, (2) the burner with the wick, (3) the glass chimney and the shade. The wick made from an absorbent material hangs down into the bowl, and sucks the liquid up to the outer edge of the burner, where it is consumed. The flame receives the air necessary for combustion through lateral openings in the burner; it is protected from draughts by the chimney, and flickering is thus avoided. The regulation of the supply of air, effects complete combustion, and thus increases the brightness of the flame, and at the same lessens the deposition of soot and the production of noxious gases. The shade intercepts glaring light that may be injurous to the eyes.

As an illuminant in lamps, petroleum is now much used; as compared with the rape-seed oil formerly employed, it gives a brighter light even with simple lamps. Petroleum is found in certain strata of the earth, where it has been formed by decomposition of debris from the vegetable and animal kingdoms; it is subjected to a refining process before use, in order to free it from substances liable to explode easily. However refined, petroleum is an in-

flammable fluid and liable to catch fire, its careless storage, or use, has led to many accidents. (*Cf.* § 144.)

§ **126. Gas lighting—Electric light.**—Brightness, steadiness, and ease in manipulation, are indisputable advantages of gas light. The illuminating gas, manufactured in the gas works from coal, by raising it to an intense heat in air tight vessels, and afterwards purified, enters directly from the pipes into the burners, and is consumed in them without any smell, and with a pleasant flame whose brightness depends on the class of burner used. Among the latter the divided burner made of soap-stone, which causes the gas to issue through a slit, and the Argand burner in which the gas escapes from a soap-stone ring pierced by numerous small holes, are preferable to the single and double burners, the apertures of which do not allow a sufficient quantity of gas to pass through them. Recently the incandescent light is largely employed. It is produced by allowing a substance composed of fire-proof materials, to be raised to a white heat by a gas-jet. This mode of lighting consumes only a moderate quantity of gas, and gives a very bright light, without evolving as much heat as ordinary gas flames. A more important advantage for our health is, the smaller production of gases of combustion.

The use of gas for lighting purposes brings in its train the disadvantage, that the heat of a room so lighted, often increases to an uncomfortable degree, and may cause headache and fainting. If, moreover, the gas becomes mixed with the air we breathe, it may endanger our health and life, by its poisonous and explosive qualities. Such occurrences are frequently observed in the case of leakages from underground gas pipes, particularly in basements, whose temperature causes a draught of air which sucks in the gas, along with it. In other instances, defects in the pipes within the houses, or careless turning on of gas jets not in use, leads

to injury to health. Fortunately, the peculiar smell of gas quickly directs the attention of persons present to the danger, which is obviated by shutting it off, and thoroughly airing the room. However, one should never enter a room in which there is a smell of gas with a naked light.

The finest, but up to the present, also the dearest illuminant, is the electric light, of which there are two kinds, the arc, and the incandescent. The former is produced by passing an electric current between two carbon points, thus forming an arc of light; however, it owes its great illuminating power essentially to particles of carbon raised to a white heat, which are detached by the current. In the incandescent light, a carbonised platinum wire enclosed in a vacuous glass globe, is raised to a white heat by the electric current. The electric light is exceptionally bright, steady, and by proper shading, pleasant for the eyes. It produces very little heat, no soot, or gases of combustion. A jumping of the light has been often remarked.

§ **127. Protection of the Eyes by shades.**—With every class of illuminant, the eyes must be protected from too glaring, and too direct rays of light; hence, where the lamp globe is not sufficient for this purpose, too bright light is moderated by various contrivances (lamp shades, &c). Lamp shades of metal, which are dazzlingly white inside, injure the eyes: hence they should be used only when the eye is removed from the direct action of the reflected rays, or when the purpose is to throw the light to a distance.

§ **128. Cleanliness in the House—Removal of Rubbish.**—A house, which is to serve as a wholesome abode for man, requires cleanliness above all things. Dust, dirt, bad smells, foul air, &c., have been already indicated several times in the preceding sections

as enemies to man's health. Their prevention and removal from the house, is a duty imposed by the fundamental axioms of sanitary science.

For this purpose, regular dusting, sweeping, and scouring are not sufficient: there is required in addition, careful removal of sweepings, domestic refuse, and human excreta from the dwelling-room, the house, and its environment.

Sweepings, and house and kitchen refuse, are most reliably disposed of by burning: however, this process is difficult on account of the large admixture of incombustible materials, which can be previously separated only at considerable expense. It is usual, therefore, to collect the refuse in question in boxes, or other utensils, and to remove them from time to time. If the emptying of the dust-bins is not carried out with sufficient care and frequency, deleterious gases are diffused from the refuse, which are obnoxious on account of their smell, and pollute the air in the house, and its immediate surroundings.

§ 129. Removal of Human Excreta.—Human excreta have always been removed quickly from the dwelling-house on account of their repulsive appearance and smell, and mostly emptied into pits, where the fluid constituents percolate into the ground, and the solid matter become decomposed and dissolved. Such cess-pools, which are even at the present day frequently met with in the country, not only make their presence felt far, and wide, by their unpleasant odour, but also pollute the ground and the water of neighbouring wells to a considerable extent, and may thus occasion the spread of dangerous diseases (*cf.* § 44). By an air-tight covering of the cess-pool, as well as by lining its sides with masonry, these inconveniencies are not removed with certainty; even the thickest materials cannot permanently resist the action of the liquid excreta. Still the pollution of the soil may be

avoided for a longer period by double cement walls, the space between which is filled with an impervious layer of clay; assuming that the contents of the pit are frequently removed by pumping, or thorough cleaning. Better plans for removing human excreta from the dwelling-house and its surroundings, are offered by the so-called pail system and the water carriage system.

In the former, the human excreta are conveyed directly by outfall pipes into hermetically closed barrel-shaped reservoirs, which are removed from time to time, and replaced by similar empty vessels. In the water carriage system, the outfall pipes open into subterranean pipes, in which the excreta are washed away by a flow of water (*cf.* §§ 136, 137).

The closet arrangements destined for the first reception of the excreta, should be placed in a room of the house, not too narrow, and as isolated as possible. This room should be well lit, to facilitate cleaning, and should be kept free from smell by thorough ventilation. Where the excreta from the closet does not fall directly into the main sewer, bad smells are prevented by frequently supplying the collecting buckets with peat mould, or disinfectants, and repeatedly emptying and cleaning them. Outfall pipes should possess a contrivance for preventing the return of foully smelling and unhealthy gases into the closet. A suitable contrivance of this kind, is the much used syphon trap, which provides, along with constant flushing of the closet, that the outfall pipe of the pan projects in a ∽ shaped bend to meet the soil-pipe. The water collecting afresh in this bend, at every flushing, separates the air in the closet pan securely from that in the soil-pipe. The soil-pipe itself is continued upwards above the level of the roof, so that the gases contained in it may escape into the open air. For this purpose the air in the soil-pipe is sometimes heated, either by a flame

burning in it, or by a neighbouring flue, and so cause the air to ascend. The soil-pipe thus serves at the same time for the ventilation of the cess-pool, bucket, or outfall pipe.

§ **130. Height of Houses, Attics, and Basements.**—The height of the rooms of the dwelling is important for the health of the inhabitants.

Lofty dwellings compel the occupiers to make frequent ascents of the stairs, an exertion which is not injurious to the healthy, but is often prejudicial to old or sick persons.

Moreover, the attics and basement storeys must be considered, from a sanitary point of view, with regard to their loftiness. In planning these apartments, it is often difficult to provide for sufficient air space, and proper ventilation; it is especially difficult to avoid on the one hand, having the attics more exposed to summer heat, and winter cold than the other apartments, and on the other, allowing the moisture of the earth, and the exhalations of neighbouring dust-bins and cesspools, to penetrate into the basement storey. In addition, in the basement storey the lighting leaves much to be desired.

§ **131. Furniture.**—As regards the utensils necessary for domestic use, and the interior decoration of the house, it must be pointed out that furniture, carpets, and other objects, sometimes contain poisonous elements.

For the most part, this is due to colouring substances, containing poisonous metallic salts, especially to arsenical dyes, which may prove injurious to health. It is well in purchasing domestic furniture, especially toys, clothing material, and carpets, to obtain a guarantee of their non-injurious qualities, *e.g.*, to have green carpets examined for arsenic.

VI.—Exercise and Recreation.

§ **132. Exercise and Recreation.**—Among the necessaries of a man's life must be included regular exercise. A sluggish body suffers injury to health even under careful treatment, and the lassitude caused by inactivity, easily leads to excesses injurious to morality and health, the results of which are dipsomania and other vices. On the other hand, body and mind require regular recreation and rest after labour, in order that their capacity for work and endurance may continue; otherwise, excessive irritability, relaxation, loss of sleep, headache, and premature decay of the faculties, may ensue. The care of the health requires a just balance between activity and recreation, for which, however, general precepts cannot be established, since the working capacity, and need of recreation, are different for every individual. Above all, it is important for health, the way the hours given for rest previous to sleep, are spent by us.

Intellectual stimulation on the one hand, and natural enjoyment on the other, occupy the period of recreation among civilized men. He whose calling compels him to undergo bodily exertion, and movement in the open air, should rest his body in his leisure hours, and should seek distraction particularly in intellectual stimulation, namely, in rational conversation, reading useful books, contemplating works of art, or in the enjoyment of music. On the other hand, he who is mentally occupied, and must spend his hours of work standing or sitting in close rooms, should seek action for his body in his leisure hours, by suitable bodily exercise, such as gymnastics, riding, etc., and should procure fresh, pure air for his lungs by staying in the open air. But where bodily suffering, or deformity have already injured the health, medical advice must in-

dicate how the leisure hours may be most beneficially occupied.

Social intercourse also affords a congenial recreation not injurious to health when confined within proper limits. The exchange of thoughts with other men stimulates the mind advantageously; moreover, the communication of our feelings and experiences is a necessity for most people, and requires social conversation, as well as proper interest in the pursuits of our fellow men. Only when social intercourse is joined to excessive bodily pleasures, when passions are thereby aroused, and the body deprived of necessary sleep (*e.g.*, gambling), does it become as injurious as over exertion. For it injures our capacity for work, makes men disinclined for labour, and leads to sickness and premature exhaustion of the body and mind. To spend the hours of recreation in regular visits to badly ventilated public-houses, full of tobacco smoke, is not only injurious to health, but also to the welfare of the individual. Still more injurious is the liberal consumption of alcohol usually accompanying it; most ruinous of all is the excessive indulgence, which leads us to the paths of licentiousness and vice.

C.—Man in his Social Relations.

§ **133. Public Health Regulations.**—In modern society the individual must often rely on the assistance of his fellowmen, to supply the necessaries of life. The preparation of good and savoury food, the making of proper clothing, the construction of healthy and comfortable dwellings, is only successful, when several persons combine their exertions. The more perfectly, agriculture and other industries, as well as art and science, are able to satisfy our multifarious needs, the more the individual is compelled to devote his powers to a particular branch, and to concentrate his exertions upon a single pursuit, so much the more need has he of the co-operation of others, to supply the necessaries of his own existence.

This circumstance, and the consciousness that in community our forces are increased for the struggle against hostile fellow beings, have caused families, septs, clans, and people to unite with one another, to form settlements in common, to seek out mutual trade-relations, and to exchange the necessaries of life. If the union of men facilitates the preparation of the means of preserving life and health, it gives rise on the other hand, to many evils prejudicial to health. The perception and removal of such injurious elements, as well as the perfecting of measures for the general health, is the object of state supervision of health, which is one of the most important and most beneficial duties of every community.

1.—Settlements.

§ **134. Importance of Settlements for Health.**—The gregarious instinct of men has contributed to those common settlements, which lie scattered over the

whole earth in the shape of groups of houses, hamlets, villages, towns and cities. In every one of these settlements, the community is exposed to certain influences, important from a health standpoint. These arise from the locality, the character of the soil, the removal of rubbish, the water supply, the extent and laying out of the settlement, the nature of the industries, the comfort and degree of civilization of the inhabitants, the provision for the poor, and sick, and the mode of burial.

§ **135. Locality.**—The same criteria offer themselves for judging correctly of the situation, and nature of the soil from a health standpoint, as are suitable for a single dwelling. It is however, usually easier to remove circumstances which are injurious to health, on account of the greater number of those engaged on the work. Accordingly the community is successful in creating a freer access of air, clearing the ground, levelling the soil, blasting rocks, &c., in freeing wide spaces of ground from damp by laying down drains and sewer pipes, and in drying up morasses which experience has proved to be nurseries of malarial diseases.

§ **136. Removal of Refuse in Centres of Population.**—The cleanliness of soil and water requires particular care in every community, since an injurious accumulation of refuse and excreta results from so many human beings living together in common. How quickly such accumulation arises is proved from this, that from experiments made in large communities every adult produces annually on an average, 34 kilogrammes of excreta, 340 kilogrammes of urine, 110 kilogrammes of solid kitchen waste, sweepings and ashes, as well as 36,000 kilogrammes of waste water of other descriptions. It is the duty of the local authorities to superintend the removal of such large quantities of refuse, and to see that the care-

lessness or indifference of individuals, may not occasion injury to the community.

As regards the removal of refuse, the cartage, drainage, and flushing are to be considered. Cartage is only of importance where the removal of dry refuse and the human excreta collected in pails and cesspools is concerned. The execution of this work is left to private persons in small communities, and to contractors in larger. The removal is best carried out at night. The carts devoted to this purpose must be air-tight, and water-tight, to prevent pollution of the atmosphere and the soil.

With regard to ordinary drainage, the water used in cooking and washing should be first carried off. The urine of men and animals is often conveyed away in the same fashion, being partly received separately in chamber-vessels and urinals, and partly segregated from the solid material by special apparatus in the cesspools and dung-heaps. For the drainage of water, subterranean closely-fitting pipes and sewers are better than the open drains and sinks used in smaller districts, as the filthy contents of the latter easily becomes stagnant, overflow, and pollute the soil.

In most large cities the solid and liquid refuse, exclusive of sweepings, is usually carried off by flushing by means of pipes connected with subterranean sewers, built with strong walls. The further removal is facilitated by a proper slope in the sewers, and by being mixed with the liquid refuse, and by flushing, which process already commences in the water closet. Rainwater is generally allowed to flow into the sewers ; it is, however, necessary to prevent the entrance of the coarser street refuse by means of gratings.

The foul and unhealthy sewer gasses must be prevented from returning into the houses by means of ventilators, as

well as by sewer-traps in the closets and gratings. To obviate flooding of the sewers by heavy rain-showers, as well as in the event of floods, escape holes are provided, through which a portion of the swollen contents of the sewers can be discharged by means of pipes.

§ **137. Final Destruction of Refuse.**—The final destruction of refuse causes no less difficulty than its removal. It is facilitated by the fact, that it yields materials necessary for the cultivation of field crops, can be used for manuring the soil, and hence finds application among the agricultural community. Attention has been for a long time directed to transforming it by suitable treatment, into a form in which it could be despatched great distances, and preserved for a long time. Efforts are made either to defer decomposition, by collecting the solid elements apart, and mixing them with dry deodorizing substances, such as turf mould, or the refuse is worked up into pulverised manure, *e.g.*, by heating it strongly with ashes and sulphuric acid, and thus destroying at once the germs of decomposition and disease. These two processes, whose extensive application is probably reserved for the future, are not as yet much used. In many towns, villages, and industries, especially in large towns, it is found more convenient to dispose of refuse by other means, and it is even usual to treat the various kinds of it in different ways.

Dry house refuse (sweepings) is here and there, *e.g.*, in many English towns, burnt, and thus provides heat for driving machinery; in Germany, on account of the higher price of coal, this process is not being extensively employed. There they prefer to pile up the refuse on isolated open spaces, although it is not easy to find sufficient space for the enormous quantities, which in Berlin, according

to a reliable estimate, amounts annually to 700,000 cubic meters, and requires 233,000 cartloads for its removal. Under certain circumstances swampy land is a suitable place to shoot rubbish, for it gains thereby in solidity by reason of the closely packed solid matter of the refuse, and thus can be more easily reclaimed for cultivation.

The contents of closet pails, cesspools, and sewers are most simply disposed, by emptying into water courses, or other bodies of water. Such a process deprives the rural population of large quantities of valuable manure stuffs, and easily produces pollution of the water, highly dangerous to the health of the inhabitants, *e.g.*, where there are not large bodies of water present, or where, owing to a strong current, a quick and scattered removal of the refuse results (*cf.* § 45). Hence the contents of pails and cesspools, are as a rule applied directly, as manure, and that in the sewers is subjected, previous to being emptied into the open current, to special treatment, by which the agriculturally valuable substances are retained, and the elements dangerous to health rendered innocuous. A treatment of this kind is known as the "precipitation process." The sewer contents are conducted into large basins, and after being mixed with chemical substances, which promote the precipitation of the solid constituents, and destroy the accompanying germs of decomposition and disease, are allowed to stand for some time until a separation of the solid and fluid elements has taken place. Then the clear fluid is run off, and the residue at the bottom is subjected to further treatment to make manure.

The "irrigation process" has in general proved more satisfactory than the precipitation; however, it can only be employed under peculiar conditions of the soil. The sewer contents is allowed to flow over, and percolate into, a somewhat gently sloping, low-lying, and well drained field,

preferably of sandy soil. The sewage matter is thus retained in the soil, wherein besides, mechanical filtration, chemical changes, and decomposition take place ; the filtered fluid freed from this matter, is conveyed into a water course, by means of drain pipes. By cultivation of an irrigated field with corn, vegetables, and other useful plants, the nitrification (decomposition) of the refuse is hastened, and at the same time its manuring property is turned to account.

One disadvantage of the irrigated field is, that in a sharp winter frost, the sewer water does not sink into the frozen ground, but seeks another exit over the surface, or in the depressions of the soil, and thus passes polluted into the water course. To avoid this, in time of frost, the irrigating water is collected in large catchment basins in which it gradually sinks into the ground.

§ **138. Removal of Waste Water of Factories.**—Special attention must be paid to the removal of waste water from industrial, and manufacturing centres. Many factories, for instance, slaughter-houses, glue manufactories, paper mills and the like, discharge refuse which produce foul odours by reason of the large quantity of the putrescent substances they contain ; nay, even poisonous substances are frequently found in the waste water of foundries and chemical works, and to the refuse of slaughter-houses, tanneries, &c., dangerous disease germs sometimes adhere. The drainage of such concerns must therefore aim at rendering their refuse harmless, and removing it completely, and for this purpose similar arrangements may be employed as are used for the removal of domestic refuse.

§ **139. Scavenging.**—The contrivances already described may also be employed for scavenging, the object of which is to remove, as quickly as possible, the dirt, animal and vegetable refuse, and snow water, collected in

the streets. Impervious pavement of well set blocks of wood, or asphalt, facilitates the successful execution of this work, and hence is more and more largely used in recent times. Besides scavenging of the streets, the labour of which is heaviest in damp weather (especially in winter), regular watering of them is necessary in dry, hot weather, to prevent by moisture, the unhealthy dust from being whirled about by the wind, as well as to cool the air.

§ **140. Water Supply.**—A thorough cleansing of the soil removes many possible causes which may lead to the pollution of the water-courses and wells; still, this does not annul the duty of carefully surveying the springs and streams which feed the supply of drinking and domestic water. Where good water is wanting, or where the catchment basins are not protected from pollution, the procurement of pure, wholesome water is one of the most urgent duties of the Public Health Authority. On this point it must be noted that the quantity of water supplied, should correspond to the consumer's requirements. It is estimated that a water supply can fully provide for all that is necessary for the drinking, washing, and domestic purposes of the household, as well as for cleaning the streets, maintaining public fountains, and for gardening, &c., if a daily supply of 150 litres is allowed for each inhabitant. Where the capacity of the water supply is not adequate for this, the laboriously procured good water ought not to be used in feeding machines and fountains, and for watering the gardens, since these requirements can be satisfied by other water drawn directly from rivers and ponds. It is also advisable, where the supply of good water is barely sufficient, to prevent waste of it by the people, either by limiting the supply for each household to a definite quantity by means of cocks on the water pipe, or by placing water-

meters in each house; the latter course facilitates the ascertainment of the quantity consumed in each house, and people are induced to be sparing in their consumption, by being compelled to pay for any surplus they may use.

Where the quantity of good water supplied is inadequate to the consumption, or where the standard of a daily supply of 50 litres for each inhabitant is not reached, a water-famine occurs. This entails consequences injurious to health, since either the cleanliness of the household is diminished, or impure surface water from rivers, ditches, and lakes, &c., is employed for drinking and domestic purposes. If the water supplied to the inhabitants of a place is purified by filtration, there is a temptation in a water famine, to allow the water to run too quickly through the filters; in this way larger quantities of water are obtained, but the purity of it is diminished, and, under certain circumstances, the health of the consumers may be endangered.

§ 141. Architecture of the Settlement.—In judging of a settlement, its architecture must be taken into account, in so far as the access of light and air to each single dwelling depends on it. In this connection the spacial extent of the settlement must be considered, for fresh, wholesome air penetrates more easily into the narrow streets of a small town, than into the wide streets in the heart of a great city. In places surrounded by fortified walls, the limited spaces necessitate the laying out of narrow streets, and the erection of high houses, while in an open town, the architecture can be made more conformable to the air-and-light requirements of the inhabitants.

The "lot-system," which provides for every single dwelling-house, a site open on all sides, and surrounded by a garden or court-yard, presents the greatest advantages for

health. This system, however, requires for its employment a large area in the settlement, which is an inconvenience to traffic, and its use is rendered difficult in large towns by the high price of ground lots; hence, we are compelled, as a rule, to connect our houses in continuous rows and groups. In this case the dwellings receive light and air only from the street, and the yards at the rere of the house —in favourable circumstances, from open squares and gardens.

In towns great importance should be attached to the establishment of open recreation spaces, adorned with gardens and parks, for they offer to many of the townspeople, especially the children, a somewhat insufficient, but still necessary and welcome, substitute for the open country. In modern times efforts are made to prevent a lack of fresh air and light in large towns by means of spacious court-yards and wide streets.

The requirements of sanitary science are enforced as far as possible by the building regulations of the public authorities, but these can only be applied to new buildings, and are not attainable in old towns, or the ancient districts of large cities. Moreover, the streets in the new portions of towns, are not always so arranged according to the prevailing direction of the wind, and the position of the sun, as to make the access of air, and light to single houses as free as possible; on the contrary, the advantageous utilisation of space, and the establishment of good communication between the central and outlying parts of the town, are made the governing considerations in planning streets.

§ 142. Dispersion of smoke and other Atmospheric Impurities — Prevention of Nuisances arising from Manufactures.— Special precautions should be taken to ensure that the air will enter as pure as possible, into the human dwellings in a

town. Good arrangements for the removal of refuse, promote the purity of the air, but are insufficient; for in the smoke ascending from dwelling-houses and factories, as well as in the gases diffused by the latter, are to be found further sources of impurities in the atmosphere, which, especially in towns, injure the breathing of the inhabitants, who are obliged by their calling to remain indoor Hence, smoke and gases should be thoroughly eliminated by proper apparatus, or at least be carried by chimneys to such a height above the houses that they will not pollute the lower atmospheric layers intended for breathing. Manufactures, which cannot be carried on, even by the aid of careful arrangements and high chimneys, without producing nuisances in their vicinity, should either be established at a distance from human dwellings, or be tolerated only on the outskirts of a large city. The same holds good for industries that are impossible without loud noise, such as coppersmiths, circular saws, ironworks, and the like. If the din caused in such workshops does not directly injure health, it destroys our comfort, and prevents the opening of windows necessary for proper airing.

§ 143. Civilisation and Well-being of the People.—How far the requirements of hygiene are attended to in the establishment and maintenance of a community, depends on the civilisation and prosperity of the people. The settlements of savage races are devoid of arrangements indispensable for health, and a prosperous municipality more easily decides on the construction of costly waterworks, and the establishment of regular transport of refuse, than a poorly-circumstanced one. Moreover, culture and wealth facilitate the pursuit of a healthy mode of life by the individual, and thus contribute to strengthen his power of withstanding

disease, while privations and improper conduct render the starving and the uncivilised, an easier prey to unhealthy influences. The illness of the individual not only deprives the community of his labour, but also requires money for his nursing, and frequently exposes the other members of the community to the risk of contracting the disease. Hence, an enlightened and prosperous community readily grants to the civil authority the power to make precautionary ordinances, and the means of carrying out measures necessary for health.

§ **144. Supervision of the Sale of Victuals —Supervision of Assembly Rooms, Theatres, Pleasure Resorts.**—The procuring of food for the people is, as a rule, left to free trading by shopkeepers and merchants, and is at most only undertaken by the Government in times of distress. Adulteration, and extortion are more blameworthy in this trade than in other business enterprises, because they affect objects which everyone, even the poorest, must buy each day, but of whose quality the purchaser is frequently not in a position to decide. Hence, on the Government falls the duty of instituting a strict supervision by experts, of the trade in victuals, and of suppressing the traffic in such provisions as may be injurious to the health of the inhabitants, from decomposition, adulteration, or other causes. Much injury may be caused by the misrepresentation of the qualities of food-stuffs and the resulting inducement to purchase: for the purchaser is thus led to spend money in a supposed necessary of life, and to pinch himself in other directions more conducive to health.*

A careful Government is also able to ward off many dangers that threaten the health of its subjects in their

* See Appendix for Summary of Laws as to Sale of Food, etc.

public gatherings, amusements, etc. Accidents should be diligently guarded against at popular rejoicings, processions, and similar displays, by proper division of the masses of people, and at enclosed assemblies, or public meetings by preventing overcrowding of halls, etc. The Government should ensure that hygienic requirements, as well as heating, lighting, and ventilating arrangements are properly attended to, in assembly-rooms, theatres, concert-halls, and pleasure resorts. It should also enforce that wide exits be provided in halls and buildings of this kind, which at all times, but especially in case of fire, will allow the audience to disperse without dangerous crushing.

§ **145. Provision for the Poor and Sick.**—Proper provision for the poor and sick must be included among the duties of the civil authority. By alleviating the necessities of the poor, the development of epidemics is counteracted, for hunger and poverty are the conditions most favourable for their spread. The anxiety for their restoration to health, must be lessened for the sick by the training of capable physicians, and of well-informed bodies of nurses, as well as by supervision of the sick clubs, and in the case of the pauper sick, by supplying proper food. The danger of improper treatment, and of insufficient precautions against the communication of disease, should be obviated by the suppression of quacks. Rules for the isolation of the sick, for disinfection, and other regulations should, in certain cases, prevent the further spread of infectious diseases. Purity of ingredients, and scientific accuracy in compounding medicines, is ensured by proper education of the apothecaries.

One essential means for promoting healthy conditions in human settlements is found in infirmaries, hospitals, and lunatic asylums, which should be placed in an airy and healthy site, at some distance from the dwellinghouses

proper of the place, and should be surrounded by gardens. In them the sick should receive medical aid, nursing, proper diet, medicine, baths, and other remedies in such an irreproachable manner, that not only the needy but also well-to-do persons, should find what is necessary for their recovery better executed in hospitals than in their own private dwellings, and the relatives of the sick person, by being relieved from the labour of nursing, may be in a position to follow their calling. These advantages, to which may be added the isolation of the sick in cases of epidemics, are however only fully present in well-conducted hospitals; improperly managed and badly arranged hospitals, contribute to the spread of diseases by their liquid and solid refuse, and by the intercourse of those outside with the patients. Hence, with the civil authority, in addition to the task of erecting hospitals, lies the duty of superintending their internal arrangement and management.

§ **146. Funeral Obsequies.**—In burials, as conducted in Germany, the body is interred in a grave about two metres deep, and then covered with earth. Putrefaction and decomposition then proceed at a relatively quick rate; in porous, sandy soil, these processes occupy from four to seven years, but it takes a longer time in an unfavourable soil, such as loam or clay, before the fleshy parts of the human body are destroyed. The vitality of disease germs, as far as our knowledge goes, is destroyed at a much earlier period; in any case these germs, as well as the gases produced by putrefaction and decomposition, are kept at a distance from the earth's surface by the layer of soil covering the coffin. To avoid polluting the water in the soil, places where water is to found only at a great depth, should be selected as burial grounds.

Well-arranged burial places do not endanger the health

of the people in their vicinity, as neither tainting of the air, nor pollution of the water are caused by them. Children who are carried every day by their nurses round the gardens of churchyards are observed to thrive well, and excellent spring water is frequently found close to burial grounds. The air is not sufficiently protected from the gases arising in decomposition, and the earth's surface is not safeguarded from the disease-germs present in corpses, where the graves are made near the surface, *i.e.* are excavated only to a small depth, or are covered with sand, or where a burial place is re-opened too soon after previous interments. Moreover, any property in the soil that prevents decomposition, over-crowding, or the presence of water near the surface. may lead to pollution of the soil and water of burial grounds. Such disadvantages cannot arise in well-conducted cemeteries ; they have only been observed in exceptional cases when after battles, disastrous accidents, &c., a simultaneous interment of an unusually large number of corpses, in a limited space, has been found necessary, but otherwise they may be wholly avoided.

The entombment of corpses in vaults is not objectionable on sanitary grounds if the vaults are not overfilled and especially if the floor, walls and doors are thick and tight-fitting. These conditions are only fulfilled in the burial vaults of single families ; walled vaults, subterranean catacombs, caves, &c., are not to be recommended for the purposes of general interment, for they do not ensure the isolation of the corpses from living persons, and they must be frequently opened and visited. Cremation, which is strongly recommended in various quarters, has not as yet been practised to any extent in Germany.

The fear of the possibility of burying still living and only apparently dead persons, is unfounded, if the regulations as to interment are strictly adhered to. The reports of cases of trance, which lasted longer than the interval

prescribed by law between death and interment, have proved on careful examination to be unwarranted.

§ **147. Inspection of Corpses—Treatment of the Corpses of Persons who have died of Infectious Diseases.**—By an inquest, or corpse inspection is meant the ascertaining of the fact of death, and, as far as possible, also the cause of death, by means of an examination of the corpse, carried out by a skilled expert, if possible by a physician; under special circumstances the body is opened to ascertain the cause of death. The legal execution of this process ensures many advantages where it is possible, and is properly carried out. It calms the relatives of the deceased, assists the administration in detecting crimes, and promotes the observance of precautionary measures in regard to the corpses of persons who have succumbed to infectious diseases.

The danger of communication of disease by corpses compels their speedy and trustworthy removal from the vicinity of living persons. Hence it is advisable to deposit corpses in isolated apartments, or mortuaries, in the cemetery until interment. Apartments of this kind should be kept cool. In order to exclude, as far as possible, the danger of communicating disease during the transfer of the corpse to the mortuary or burial ground, the dead body is wrapped in linen cloths saturated with disinfecting fluids, prior to being enclosed in a well made coffin. Chance discharges from the corpse, prior to decomposition setting in, are absorbed by sawdust, turfmould, &c., spread at the bottom of the coffin, and are thus prevented from becoming visible. The destruction of especially dangerous disease germs present in the body, may sometimes require quicklime to be scattered in the coffin, and the grave.

§ **148. Removal of Dead Animals.**—Similar

considerations in regard to health, as are taken into account in the burial of human corpses, also determine the removal of dead animals. As a rule the carcases of large animals are buried in remote spots, which fulfil the same conditions as are necessary for human burial grounds. Dead animals are more quickly destroyed by burning, or by being used up in the manufacture of glue, manure, &c. The persons following the business of removing animal carcases are called knackers, or skinners.

II.—Commerce.

§ **149. Objects of Commerce—Means of Communication.**—The manifold relations, and points of contact, which exist among men in their settlements, are increased by traffic, from place to place, from country to country. Commercial intercourse between individuals, and nations, has existed since the most ancient times of which we have historic knowledge. Travelling was, however, up to a few decades ago, so difficult or costly, that the number of persons who resolved to leave their homes, and undertake distant journeys, whether for pleasure or instruction, for industrial or commercial purposes, or on account of their profession, was very small.

If one did not wish to reach their destination by laborious walking, considerable sums had to be expended for horses and carriages, and where journeys by water were necessary, the ship's voyage was of uncertain duration, because dependent upon the direction and strength of the wind. Since then, the means of transit have been perfected in an unexpected manner, by the ever increasing application of steam, and recently of electricity. To-day, a distant journey entails very little trouble, time, and money,

as compared with former years, and hence the number of persons travelling every year, and the quantity of goods conveyed, has increased enormously, so that, according to an imperial epigram, the end of the 19th century is ranged under the standard of commerce.

§ **150. Travelling.**—The expansion of traffic has caused certain consequences, which it entails on human health, to appear more prominently or differently than before. For individuals travelling at the present time, appears to be, not only more comfortable, but also more healthy than formerly. Legal regulations, and government inspections, prevent uncleanliness and overcrowding in carriages, and provide for their necessary ventilation, heating, and lighting. The arrangements for the health and comfort of travellers on railways and steamboats are being constantly improved, and it frequently happens, that persons seriously ill can be conveyed to far distant places without incurring any risk by travelling.

The impression conveyed from a cursory survey of railway and steamboat accidents, that the danger of travelling has increased by reason of the modern modes of conveyance, must be described as erroneous. The accidents are extremely small in number, as compared with the immense extent of the traffic. They appear dreadful to many, merely because, as a rule, a greater number of men are sacrificed at the same time, and all accidents are speedily announced by the newspapers, while formerly, in accordance with the mode of conveyance, the accidents in travelling were almost always confined to a few individuals and were more easily withheld from public notoriety.

Injuries to health by travelling can rarely be ascribed to the mode of conveyance, but an individual traveller may invite illness on his journey by imprudent or improper conduct. Travelling makes many demands on the body ; the

customary mode of life is altered, for in place of the accustomed food, a diet partaken of, at different times, and different in character and preparation, is used, and sleep must be sought at different hours. Besides, the quick change of climate occasioned by travelling from place to place may endanger the health, and no small risk arises from the possibility of catching disease through contact with strangers, and by spending the night in strange rooms, and beds. When travelling, we should strive after a more moderate mode of living than at other times; we should avoid excesses of every kind, which may reduce our powers of bodily endurance, and we should protect ourselves by proper clothing from sudden changes of temperature and other meteorological influences. In railway carriages, we should provide pure air by suitable use of the ventilating apparatus, and judicious opening of the windows, but we should be on our guard against causing injurious draughts, and against leaning the upper part of the body from the carriage window. Such imprudence has cost many a man his life, for the carelessly closed door has opened under the weight of the body leaning against it, and many an eye has been injured when leaning from the carriage window by the keen current of air, or by the dust.

Moreover, we should seek board and lodging only in clean, well managed hotels, and should avoid too close contact with strangers. On long journeys we should not omit allowing ourselves a day's rest from time to time, to protect the body from over exertion.

§ 151. Prevention of the spread of Infectious Diseases by Commercial Intercourse.—If the perfecting of modes of conveyance has been rather advantageous than injurious to the health of travellers, it has on the other hand increased the danger of spreading infectious diseases for the people in general.

The increase of traffic, and the speed with which at present long distances are taversed on railways and steamships, favours the possibility of introducing contagious diseases, and hastens their progress from place to place. Various efforts have been made to meet this danger of importing disease.

The frontiers, or municipal boundaries are closed against traffic from all districts which are visited by contagious diseases; or persons coming from such districts must spend a certain time in quarantine, and allow their state of health to be examined, and their clothing and luggage to be disinfected before they can pass the frontier of the country in question. Finally, the importation of those goods from which a communication of the disease is feared, is forbidden, or allowed only after disinfection. However, the end in view is not attained by all these regulations, usually considered as highly inconvenient.

§ **152. Blockades and Quarantines**.—The complete suspension of traffic from without, may be possible for remote districts, or small islands; in all other cases, especially on the frontier as experience shows, it is regularly broken, in spite of the presence of large bodies of guards. Nay, it has frequently been, the guards, or troops employed in the blockade, who have caught the disease from strangers, and spread it. It is found easier to intercept ships on their arrival, and to prevent intercourse with the land until the period of observation has elapsed. But the success of such sea quarantine has not corresponded to expectations, for cases of sickness which appeared on board during quarantine have been concealed, or remained undiscovered, and have subsequently become the nucleus of further cases of the disease in the port.

The regulations directed against the conveyence of inanimate objects have been frequently too stringent. Of

course cases are known in which contagious diseases have been actually transmitted by parcels, postal packets, &c., but the number of diseases to which such experiences refer, is small, and there are only a few definite objects which can be accused of spreading contagious matter. Even rags, feathers, wool, &c. (whose capacity for absorbing and disseminating the germs of many diseases is indisputable) may be safely sent when carefully packed, and securely closed, if their further use at their destination is permitted only after disinfection executed under careful supervision.

§ 153. Prevention of the importation of Cholera into Germany.—In Germany the above mentioned defensive measures against the introduction of infection by traffic, are reserved for a small number of rare, or little known epidemics.

To prevent the introduction of cholera into districts, not yet attacked by the epidemic, persons travelling from cholera districts are subjected to observation for several days, without essentially interfering with traffic. Isolation follows only in case of illness. Stricter supervision, and occasionally interruption of the traffic, are applied against vagrants, or those possessing no fixed residence, and professional travellers by whom epidemics are most easily introduced. They are especially enforced against gypsies, tramps, foreign refugees, and dwellers on river boats. Moreover, popular festivals, markets, pilgrimages, etc., are forbidden in places immediately threatened with the epidemic, for the disease is often carried far and wide, by the crowds coming together on such occasions, as experience has frequently shown. Restrictions on goods traffic are only imposed under certain conditions, in regard to milk, second-hand underclothing, and bedding, old and worn clothes, and rags.

§ **154. Additional Risks from Goods Traffic.**—Danger to health is not confined, so far as goods traffic is concerned, to the possibility of introducing contagion. The conveyance of provisions, dainties, and household foods of various kinds, for great distances, sometimes causes such objects to become putrid on the journey, and thus produces illness among the purchasers or receivers. In packing objects of this kind and in transferring them to the mode of conveyance (railroads, etc.), the recommendations set out in § 86 and § 100 in regard to storage, must be followed with especial care. It is also advisable to consume packages of provisions sent from a distance, only when we have assured ourselves, that no indications of decomposition are perceptible in them.

III.—Rearing of Children.

§ **155. General influence of Education on Health.**—An evidence of the progress attained by the union of men in commonwealths lies in the enhanced mental development of the people. The emulation of nations in securing and improving their relations, compels them to set the ideals of popular culture much higher than formerly, and therefore to provide that a certain minimum of knowledge will be imparted to every healthy child. Accordingly primary education is a vital question among every civilized nation. While formerly it rested with the individual, the manner he wished to rear his children, and train them intellectually, compulsory school-attendance is now enforced by law. However, it extends only to the primary school, *i.e.*, to instruction in the knowledge necessary for everyone in order to engage in the battle of life. But many professions require a more extensive general culture in school, than the

elements necessary for understanding the obligations imposed on us, and for success in the industry we pursue. These requirements are met by a course of education in the grammar schools and universities, extending over a longer period. However, by an exclusive development of the intellect, the bodily powers are hindered and stunted in their growth. Not only is the individual a sufferer in this event, but also (if the neglect of physical development is general), the people at large. The decline in physical power increases from generation to generation, the nation degenerates, and finally is no longer in a position to defend itself from external enemies. It is, therefore, the duty of parents and teachers, as well as of the State, to see that the rising generation are fully cared for, and protected from injurious influences, and that the necessary training of the intellect does not interfere with the healthy development of the youthful body.

§ **156. Infant Mortality.**—At no epoch is a man's life exposed to such danger as during his earliest childhood. In 1892, according to the reports of the Imperial Health Department, 33·9 per cent. of the deaths in the German Empire, 36·6 of those in Bavaria, and 37·0 per cent. of the deaths in Berlin, were infants under one year old ; in other countries and cities death also claims numerous victims among children of that tender age. Of every 100 children born alive in the German Empire, 22·9 ; in Prussia, 21·1 ; in Bavaria, 27·5 ; and in Saxony, 29·8 die in their first year, so that only about three-fourths of those born alive survive the first year of their life. The extent of infant mortality is subject to considerable variations according to the season, and the district. About one-third of the cases of death among children of this tender age occurs in the months of July and August, and in large cities infant mortality is much higher than in rural districts.

More illegitimate children die in their first year than legitimate, chiefly from want of proper care and attention.

§ **157. Infant Food**.—The most frequent illnesses of the first year of childhood, are caused by improper nourishment. Many mothers cannot, others will not, suckle their children, whether from motives of health or gain, or, as often happens, from no morally justifiable cause. It is possible for only a few parents in such cases, to provide a complete substitute in a wet-nurse: the greater majority of these children are entirely deprived of their natural nutriment—mother's milk. The milk of the cow, or other animals forms their chief food: this is most suitable for them next to mother's milk, but it should be kept free from any impurities, thinned before being used, mixed with sugar, and well boiled (§ 75).

Ignorant mothers who wish to provide their infants with strong nourishment, in the shape of pure, or little diluted milk, often cause the infant stomach, inflamed by the heavy diet, to partially reject the food offered to it, and sometimes severe disorders of the digestive organs are the result.

Many children thrive well if they receive preserved milk, along with, or in place of, fresh milk. Similarly, well boiled, and thoroughly strained broth, made from oats, barley, and other cereals, may be given to children more than three months old, as an adjunct to milk: still it must not be forgotten that the nutritive qualities of such broths are far inferior to those of milk. Too premature attempts to nourish children on adult diet, is almost certain to be punished by severe digestive disorders. The dreaded vomiting fits of infancy are frequently the result of neglect of cleanliness in storing and handling the milk supplies; hence they cause more deaths among children fed on animal

milk, or farinaceous substitutes for mother's milk, than among infants fed at the mother's breast.

Light biscuits are usually eaten without injury by children in the last quarter of their first year, and soft boiled eggs, at the expiration of that year. Many children learn to assimilate easily digestible meat in the course of their second year, but in general it should be given to them only towards the end of that year. Similarly, light vegetables, potatoes and fruit are best reserved for the last mentioned period. Subsequently, children easily accustom themselves to a diet increasing in strength: still food difficult to digest, or strongly spiced dishes, and alcoholic liquors, should be entirely withheld from them. Pampering children with sweetmeats and other dainties is a bad habit, which not only injures their rearing, but also undermines their health by leading to teeth diseases, and digestive disorders.

§ **158. Baths, Children's Clothing, Necessity of Fresh Air, Diseases of the Eyes in Newly-Born Infants, Sleep, Causes of Children Crying.**—Cleanliness is an indispensable requirement of the proper rearing of children. To make children thrive well, their bodies should be bathed every day, their hair, and the folds of skin found at the joints should be carefully washed, and the parts most exposed to dirt should be powdered, and in some cases greased. The skin of badly-tended children easily becomes sore and covered with eruptions, which hinder their bodily development. The infant body is very sensitive to chills. Hence warm water of a temperature of about 34°C. should be selected for the bath, and warm clothing and bedding ought to be provided. However, it is a stupid precaution to deprive them of fresh air out of doors, if the fear of colds, or wettings, is not well grounded from the presence of high winds, rain or snow-

falls. Healthy children, even a few weeks after birth, should be daily carried into the open air.

Special attention should be paid to the eyes of newly-born infants. The dreaded diseases of the eyes (*cf.* § 218), which unfortunately sometimes leads to blindness in young children, can almost always be cured by prompt treatment. Hence, there should be no delay in summoning medical aid as soon as red eyes, closed lids, or drops of mucus in the corners of the eyes, herald the beginning of inflammation. Daylight is not injurious to the eyes of healthy children, unless the sun shines too glaringly through the window. Quiet should prevail in the nursery, as the infant in its first months requires plenty of sleep. The crying of infants frequently represents merely the expression of awakened life ; it is the language in which a child makes known its wants. A child that cries much is sometimes hungry, and becomes quieter as soon as the quantity of regular food is increased, or altered in composition. The cause of the crying may often be found in a wet cloth, or in the pressure of an improperly arranged piece of clothing. The fear that illness is the reason of the crying is rarely well founded ; on the contrary a lusty voice is not unjustly regarded as a sign of health.

§ **159. Cutting the Teeth; Development of Speech; Standing and Walking.**—In the second six months of life, the cutting of the teeth causes much discomfort. Painful swelling of the gums sets in, saliva is largely secreted ; the children often put their fingers in their mouths, sleep uneasily, and are tearful and depressed. Slight feverishness may also be traced to the teeth. Other symptoms of illness frequent at this period of life, such as eruptions, spasmodic convulsions, coughs, high fever, &c., have usually nothing to do with cutting the teeth, and are at most made worse by

their simultaneous appearance. The custom of ascribing all illness at this age to the cutting of the teeth, and for this reason omitting to call in medical advice, while help was still possible, frequently brings its own punishment in the death of the child.

Towards the end of the first year the child begins to babble its first words. The development of speech is accomplished as a rule without any difficulty, and is not influenced by the nature of the cord which joins the tongue to the bottom of the oral cavity. If the cord is too short or somewhat tight, it is gradually extended by the movements in speech. The popular loosening of the tongue by a slit in the cord is superfluous, and may give rise to inflammation.

At the same age children begin to stand and walk. They require then watchful supervision, lest they may be injured by falling. In many cases, as a consequence of a weakness of the bones, caused by a disease called "rickets," the desire to learn to walk is exhibited at a much later period. To encourage such children to walk too soon is senseless: long lying is advantageous for them, as their weak limbs become deformed in walking, owing to the weight of the body: hence children suffering from "rickets" should not begin to walk till two or three years old.

§ **160. Awakening of Intellect; Kindergarten.**—By degrees the awakening of the faculty of thought, the dawn of intelligence, and the growth of volition, demand for the child the education of his mind, in addition to the care of his body. The more respect that is paid to natural development in this direction, and the less the infant faculty of apprehension is burdened with unnecessary impressions, the slower, but healthier is the expansion of the intellect.

Parents, who from their occupation, illness, or other impediments, are prevented from devoting their entire time and labour to the education of their children, derive welcome assistance from the "Kindergarten." There, the children enjoy themselves in common games, and at the same time receive their first useful instruction. The dimensions and fittings of "Kindergartens," are to be decided in the same way as schools, so far as hygienic science is concerned.

§ 161. School-hours, Duties of the Government Masters, Teachers and Parents.—With his entry into the schoolroom, a notable change takes place in the child's mode of life. A part of the day must be spent in prescribed occupations, mental and bodily exertions are required, and the child becomes acquainted with the idea of "duty."

The sense of justice requires, that in a State, where attendance at school is compulsory, the children should be exposed as little as possible to dangers to health, through fulfilling the duties demanded from them by society. It rests with the head of the school to see, according to the standard laid down in the regulations issued by the State for this purpose, that neither the arrangements of the school, nor the class of instruction occasion injury to the health of the scholar; but the teacher should observe each of the children entrusted to him, and attend to the peculiarities of his bodily or mental constitution. This however, does not exempt the parents and home teachers from their duties towards children. The observation of the child's conduct during leisure hours, of his appetite and sleep, leads much more easily than is possible during school-hours, to the discovery of derangements of his health, or defects in his development. Often an explanation with the teacher, or head of the school, leads to timely discovery, and prevention of danger threatening the

child's health. Suitable treatment at home, bodily exercise, walks, proper management of irregularities, strengthen the power and capacity for undergoing the efforts required by school instruction.

§ **162. The Schoolhouse and Schoolroom.**—The requirements of a schoolhouse are essentially the same as those of a dwelling-house (§§ 111-131), but the lecture rooms proper, must fulfil special conditions founded on experience. Their length, breath, and height should not exceed a certain standard, because the writing on the blackboard must be capable of being read from the hindmost bench without special effort, the seats near the wall furthest from the window must receive sufficient light, and the sound must not be injured by too high a ceiling. As a rule, these conditions are fulfilled by a schoolroom not more than 10 metres long, 7 metres wide, and about 4 metres high, and such a room possessing an air capacity of nearly 280 cubic metres, would accommodate from 50 to 55 children. If the space reserved for each pupil is relatively small (*cf.* § 116), it must be borne in mind, that schoolrooms are occupied continuously only for a short time. However, so large an attendance is only permissible on condition, that in the intervals between lessons a thorough renewal of the air in the room is ensured by opening the doors and windows, and that suitable apparatus provide constant ventilation during the hours of study.

The choice of heating apparatus for a schoolhouse is determined usually by the climate, and other local conditions as well as by the size of the building. For large schools a collective heating system combined with ventilating apparatus, is generally preferred. Experience proves a schoolroom temperature of 18°C. to be sufficient for the pupils.

The walls, floors, and fittings of a schoolroom should be

as level as possible; nowhere should corners, joinings, or crevices afford resting places for dust and dirt. Even then it is not very easy to prevent the accumulation of dangerous refuse but by regular and thorough cleaning.

A vice frequently developed even in childhood, is constant spitting; healthy children should be restrained from acquiring this evil habit on grounds of good breeding and cleanliness, and only in cases of illness should children be allowed to expectorate. Such coughing pupils, however, should be strictly compelled, both inside and outside the school, to deposit their expectoration in their pocket handkerchiefs, not on the ground or floor of the room. For spitting on the ground results, in disease germs becoming mixed with the dust of the room, and these, when inhaled with the dust particles blown about the room, may be fatal to other children.

§ 163. Relation between the lighting of Schoolroom and the origin of Shortsight.— The lighting of the schoolroom is very important in regard to health, for defective light helps to produce shortsightedness, and curvature of the spine, to which school children are disposed. A sickly bodily constitution frequently lies at the root of both defects; however, the development of shortsight is favoured by the exertions required from the eyes when reading, writing, or drawing in badly lighted rooms, just as spinal curvature easily appears in young persons, if they have to bend their head constantly near the table in the effort to place their eyes close to the defectively illuminated book or manuscript. The daylight should not be prevented by houses, walls, or trees from penetrating into the school-room. High, wide windows, whose illuminating surface should amount to about one-fifth of the floor space, afford plentiful access for light; walls painted bright grey, or blue, favour the diffusion of light, and do not dazzle. It

is best for the light to fall on the pupils' seats from the left, or from above; if it comes from the front, it dazzles; if from the back, the child's shadow obscures the surface of the desk before him; if the light comes from the right, the pupil in writing is disturbed by the shadow of his hand or pen, and is thus led to sit crooked. If daylight proves insufficient in the short dull winter days, there should be no lack of artificial light, the selection of which must be decided in the same way as for a private house.

§ **164. School-benches and Spinal Curvature.**—The character of the school desk, in addition to the lighting, influences the development or prevention of spinal curvature. Negligence in maintaining the upright

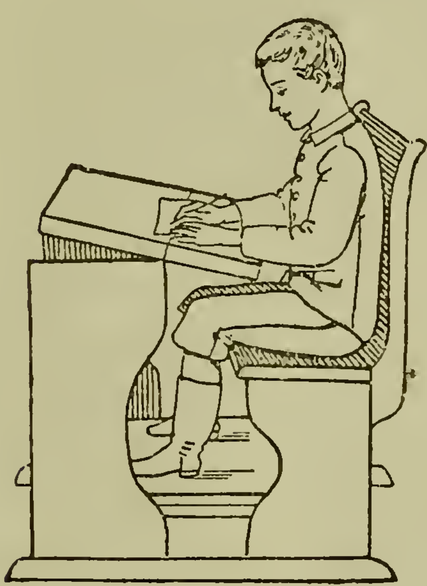


Fig. 39.
Pupil Writing in Good Position.

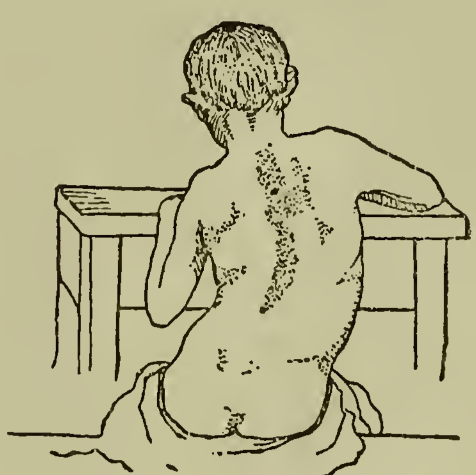


Fig. 40.
Pupil Writing in Defective Position.

(After Von Esmarch.)

carriage of the body is most easily avoided, if the pupil can assume and maintain the writing position without muscular effort (Fig. 39). A high seat, which when the knees are bent at right angles, does not allow the feet to rest on the ground, or a narrow bench which does not afford room for the whole upper thigh, tires the muscles of the legs. A too small

elevation of the slab of the desk from the seat enforces an inconvenient stooping of the head. If the desk is too high it makes it difficult to place the writing arm on it and causes an elevation of the right shoulder ; a distortion of the body is produced, and at the same time the eye is brought injuriously near the writing level (Fig. 40). Too great a distance between the back of the desk and the front of the seat, causes necessarily, a bending of the spine, strains the muscles of the back, and hinders respiration.

In recent years the school authorities have endeavoured to arrange the lighting arrangements of the school-room and, so far as the various statures of the pupils united in one class permit, the school desks are more and more in accordance with hygienic principles. Still there are children who fail to sit upright even in well-lit rooms, and with proper seats. It is then generally a question of a bad habit, which the pupil should be urgently induced to lay aside ; in exceptional cases the faulty carriage may be due to illness, which may take a disastrous course unless promptly checked, and hence the parents and teachers of such children would do well to seek medical advice.

The injurious effect of sitting crooked is displayed not merely in short-sightedness and spinal curvature ; it sometimes occasions interruptions in the circulation of the blood, so that it may lead to effusion of blood in the brain, headache, and bleeding from the nose.

§ **165. The alleged Overpressure in Schools—Injudicious Division of School Work.**—Of late some persons wish to consider such injuries to health as the results of over-exertion, and have thereupon accused the higher schools of overburdening the pupils entrusted to them. This report, however, is in general unjustified, and frequently exaggerated. A certain degree of effort must be required from the pupil, since not

only the instruction of the young, but also the training of industrious and loyal citizens, constitutes the task imposed on our schools. Among other things home exercises are indispensible, because the pupil learns to think independently, only if he is obliged to work alone. The plan of studies in the German school system is throughout adapted to the working power of infants and youths, and careful supervision by the State, and the heads of the schools, ensures that no individual teacher shall overwork his pupils. If, however, signs of mental over-exertion appear in many pupils, such as a discontented and depressed demeanour in the daytime, stunted physical development, or sickness, in the larger majority of cases other circumstances are to blame, most frequently an improper division of work. If the preparation of home exercises is begun only a short time before they are to be handed to the teacher, and the hours not occupied by instruction are exclusively devoted to play and pleasure, then the period of sleep (with which children and young persons cannot dispense without injuring their health), is shortened, and the pupils are not able during the daytime to follow their instruction with the necessary freshness and attention. At the same time, the home exercises, which in such cases are plainly performed with a certain reluctance, do not meet with the teacher's approval; the memory and understanding of the learner do not sufficiently assimilate the material supplied to them, and then the pupil's efforts must in fact be increased beyond his capacity if the desired goal of advancement to higher classes, or of a satisfactory certificate is to be attained.

§ **166. Mode of Life during the period of Attendance at School.**—The disadvantages just described become still more prominent by an injudicious mode of life. Regular care of the body should go hand in

hand with intellectual development. The recreation time, and especially the holidays, should be devoted to walks, gymnastics, swimming, skating, etc., and not spent indoors. The diet of a growing youth should be simple; early habits of alcoholic drinking and smoking, undermine the health, and should be carefully restrained. Staying up late at night has extremely injurious results, and therefore, bringing school children to the pleasures of adults, whereby frequently late hours are taken up, is most injudicious. The participation in noisy amusements, the holding of formal children's parties, visits to theatres and concerts, should not at all, or only in exceptional cases, be permitted to young persons, for all such pleasures have generally the result of withdrawing the pupils' thoughts from their tasks and duties. The same holds good of improper books, such as histories of revolting crimes and many romances, whose perusal excites the imagination of undeveloped minds excessively. For it has happened, that by reading bad books the ideas of morality and honour have become so distorted that pupils of ill-balanced intellect have not shrunk from suicide, from extraordinary motives. On the other hand, supplying good books, which can awake a sense of right, and the appreciation of beautiful forms and thoughts, is both advisable and beneficial; and those recreation hours should be given to them which unfavourable weather does not permit to be spent in the open air. Instruction in music, and the other arts is recommended exclusively for boys and girls having a taste in that direction; and even in their case, care must be taken that their additional labour does not interfere with their school duties, nor shorten their hours of recreation, so as to avoid over-exertion.

§ **167. Development and Protection of the Body in School—Gymnastic Training.**—The physical development of boys and girls should not be

overlooked in school. The teachers should observe the deportment of their pupils, give them advice and hints regarding it, and draw the attention of their parents to it, either by remarks on their school certificates, or by personal explanation, where home interference is necessary. Pupils suffering from contagious diseases should be kept apart from the others, or be exempted from school attendance, along with their brothers and sisters, until the danger of infection is past; in more extensive outbreaks of infectious diseases the classes or schools affected, should be entirely closed for a time.

Gymnastic training promotes the strength and agility of the body and its members; attention should be paid to chance fractures resulting from it. Anxious parents act unreasonably if they hinder their children, without sufficient cause, from participating in this beneficial physical development. The injuries occasionally sustained in gymnastic exercise, are almost always of a trivial character, and give no occasion for its prohibition, since such accidents would be more frequent without gymnastic training. The masculine youth requires violent exercise, and would seek to satisfy his craving for it by indulging in wild sports to a greater extent than at present, if gymnastics and gymnastic games fell into disuse.

§ **168. Capacity of the Pupils.**—If children in spite of obvious efforts, are unable to master the tasks set them in school, and give rise to fear that their health may be injured by over-exertion, the question presents itself to parents and teachers, whether the class of instruction selected is not disproportioned to the pupils' capacity. Sometimes a change of school is still useful, if it is possible to select, in place of a largely-attended school, a smaller establishment in which the teachers can devote more attention to individual pupils. But if this resource is wanting,

and if laziness or negligence may be safely excluded as the cause of the lack of progress, no further time should be lost in changing the nature of the instruction. Many a pupil who finds almost insuperable difficulties in the acquisition of languages, embraces the study of mathematical science with ease; and physical skill, and powers of observation, secure a high position in life for many, who could only play a subordinate part in the learned professions. The decision upon the necessity of a change in the course of studies, is made easier for the parents, by the explanation of the teacher, and by medical advice. The desires of the child should not be conclusive on this point, for youth easily errs in its wishes, and the craving, whose fulfilment determines part of our career, is frequently regretted when the intellect has become riper.

§ 169. Female Education in Particular.—Some special precautions must be observed in the education of girls. The girl requires care and indulgence far more than the boy, for over-exertion of her tender body often revenges itself in chlorosis (green-sickness), irritability, nervousness, and other indispositions. Girls' schools should, therefore, carefully avoid all over-pressure of the children entrusted to them, and mothers should lovingly guard, and encourage their daughters. Only girls whose mental faculties, and healthy physical character guarantee their fitness, should be selected for training for the laborious, scientific, and other callings, which society has now thrown open to women.

IV.—Employment and Wages.

§ **170. Advantages and Disadvantages of Special Occupations in Relation to Health—Factory Inspectors.**—As soon as school years are over, training for their future employment begins with most young people. Many, even during this period of training, but all at the end of their apprenticeship, are subjected to new influences, determined by the class of employment they select. Whether it is a question of factory workers, handicraftmen, agricultural labourers, artists, officials, or savants, the individual is generally placed in the peculiar relations of his calling, which may exert a favourable or unfavourable influence on his health. Of late years scientific enquiry has been particularly directed to the discovery of the injurious results of various trades on the persons engaged in them. Enquiries in this direction have been set on foot by the State, since the pursuit of a number of industries was placed under the supervision of certain officials (Factory Inspectors), who, besides discharging other functions, are entrusted with the duty of reporting as to the healthy, or unhealthy character of particular industries. The knowledge acquired in this way, which is being constantly added to, has in many cases made it possible to counteract injurious influences, either by perfecting the arrangements for the well-being of the workers, or by special legal enactments, or Government regulations.

A complete removal of dangers in workshops is impossible; the object of the efforts referred to, must rather be, to confine the risks of every employment within the smallest limits compatible with the purpose for which the labour is designed. Too far-reaching precaution, or supervision would result in this, that with the removal of the

danger, a decrease of the products would follow, and that the individual, as well as persons combined for the purpose of common labour, and finally the nation at large, could not exist in competition with other less considerate workers and nations.

§ **171. Importance of Choice of Occupation. Prevention of delicate persons from engaging in laborious Employment; Limitation of hours of Labour for Women and Children.**—The proper choice of employment is essentially important. He who devotes himself to a trade, without the physical capacity necessary for it, generally suffers most easily from its injurious effects. Hence, the admission to many wage-earning employments—*e.g.*, employment in mines, or on railroads, as well as service in the army and navy—is made dependent on satisfying physical inspection. Previous to entering into positions which demand mental labour in particular, the intellectual capacity of the applicant should be tested. He should produce evidence of his education, and of the degree of mental development he has attained. The employment of women, and children, in callings which demand severe bodily labour, is partly limited, and partly forbidden by statute.

As the State, however, is able to influence the choice of calling, only to a limited extent, without encroaching on personal freedom, the responsibility for selecting a trade, after prudent consideration of capacity as compared with the labour entailed, rests chiefly with the individual, his parents, and guardians.

§ **172. Duration of Daily Work.**—In every business too prolonged duration of daily work, in proportion to man's working powers, may prove injurious to health; still it is difficult to lay down a standard time which may be uninterruptedly devoted to work without entailing injury

to the worker (*cf.* § 132). Not only must the class of employment be taken into account, but also the personal working capacity, and style of workmanship, of the individual. Many complete their tasks slowly; others quickly. One man requiries numerous short intervals of rest; another refreshes himself by rarer, but more extended interruptions of his labour. A uniform determination of the working time is unavoidable in industries employing many persons in the same way. Hence in the German Empire, the working-hours in each industry are regulated by the labour bureau. Moreover the Federal Council has the right of prescribing the duration, and time, for beginning and finishing, the daily labour, and the intervals to be allowed to the workers, in industries in which the health may be endangered by excessive length of the working day.

For young, and female workers, the length of the working day is fixed by law.

An important step in recognising man's need of recreation by legal enactment, has taken place by the introduction of the regulations as to Sunday rest, to which religious motives, and considerations of health have given occasion.

§ 173. Injuries to Health by over-working single parts of the Body.—In addition to general over-exertion due to a difficult or prolonged labour beyond our strength, the special exercise of single parts of the body, such as certain groups of muscles, or sense-organs, may have injurious results. Persons who write or sew much, or play the piano constantly, or engage in other occupations demanding constant exercise of the muscles of the hand and forearm, sometimes contract a troublesome disease of the nerves, best known as "writer's cramp." The occupations of professors, gold-workers, watchmakers, etc., necessitating much labour with small objects, with manu-

script or printed matter, injure the power of vision. Glaring light combined with sudden changes between brightness, darkness, and radiated heat, frequently produces diseases of the eye in forges and glassworks.

Moreover, the constant posture required by callings, which interferes with the circulation of the blood, and other functions of the body, may cause injurious effects. The bent position of the upper half of the body required by the work of shoemakers, tailors, and sempstresses, restricts the expansion of the chest, and in this way sometimes leads to asthmatic and pulmonary diseases. Again, long sitting obstructs the circulation of the blood, and the intestinal functions, and may be the cause of stagnation of the blood, irregular digestion, and defective blood supply. Among persons largely engaged in mental labour, *e.g.*, professors and officials, these sickly conditions are frequently associated with nervous disorders, headaches, unaccountable dulness and depression, exaggeration of trifling indispositions, etc. Long continued walking and standing, hamper the return of the blood from the lower limbs to the heart, and, *e.g.*, among tapsters and laundresses, may occasion swelling of the feet and ankles, varicose veins, or ulcers on the lower limbs.

§ 174. Influence of the Weather—Effect of Excessive Heat.—Diseases of the respiratory organs, and rheumatic pains in the limbs are frequent among husbandmen, builders, drivers, railway officials, sailors, and many other persons, who, by their calling, are exposed to the changing influences of the weather, more especially workers employed in the lower levels of mines, where they must stand for days in the water. Smiths, men engaged in smelting works, stokers, and glass blowers often contract skin diseases in consequence of the intense heat of the furnaces in which they work. Such external in-

fluences are borne without injury by the majority of persons exposed to them, because the human body generally becomes inured, and, as it is said, hardened to them.

§ **175. Dust-disease.**—In some industries the workers are compelled to inhale dust, which, according to its nature, may injure the health in various ways. Soft kinds of dust are least injurious, when they do not consist of poisonous substances, and are not polluted by disease germs. The coal-dust inhaled by the coal-heaver, the soot by the chimney-sweep, the graphite-dust by the lead pencil maker and moulder, produce respiratory diseases only in exceptional cases, and the same may be said of the wood-dust inhaled by the cabinetmaker and sawmiller. On the other hand, the diseases of the teeth so frequent among bakers and confectioners, are ascribed to the inhalation of flour-dust, which remains lying in the interstices and hollow parts of the teeth, is converted into sugar by the action of the saliva, and forms a favourable feeding ground for the germs of fermentation, as well as for bacteria.

The origin of many lung diseases is traced to the dust of establishments for polishing glass, metal, and stone. For the sharp edges and points of the particles of glass, metal, and stone, produce injuries in the sides of the branches of the windpipe and lung vesicles, and thus afford numerous inlets for inhaled disease-germs.

The nature of some industries brings with it the danger that the particles of dust in the material to be manufactured, are mixed with infectious substances, which pass into the worker's body, not only by his breath, but also with his food, and may produce illness. Disease germs adhere very tenaciously to rags, bed feathers, etc., that have been used by sick persons: hence the sorters in paper works, and shoddy factories, are exposed to contagious diseases, and it has been proved that smallpox has been

communicated to workers in shops for remaking feather beds, in the course of their employment. The manufacture of hides, and hair of beasts that died from anthrax, have sometimes caused cases of this fatal disease.

§ **176. Noxious Gases**.—In some industries, occupied with the manufacture of poisonous substances, the workers may suffer injury from inhaling poisonous dust due to the improper arrangement of the working plant. More frequently however, the air of the workrooms becomes dangerous to health, through contamination with noxious, or poisonous gases. Thus bleachers, straw-workers, persons engaged in the manufacture of alum, glass, ultramarine, sulphuric acid, and white lead, &c., are often exposed to the inhalation of sulphurous acid gas. Similarly, hydrochloric acid gas is produced in soda works, chlorine gas in the manufacture of chloride of lime, and in quick bleaching processes. The employés in gasworks, as well as those engaged in laying down and repairing gas-pipes, run various risks from coal-gas, and workers in mines and tunnels, are in danger from subterranean gases.

§ **177. Poisoning by Metals or Phosphorus**.—In the manufacture of metals, poisonous effects may result, not only from inhalation of fumes, but also by poisonous substances adhering to the hands, being conveyed to the mouth along with food. In this way arise mercurial poisoning among mirror-platers; lead poisoning among compositors, painters and lacquerers using lead colours; among potters and workers in white lead factories; arsenical poisoning among persons employed in making and using arsenical colours, such as green, and in the manufacturing of artificial flowers. Similarly among those engaged in phosphorus works, and especially among workmen employed in making matches, tipped with white

phosphorus, the phosphoric fumes produce bad teeth, finally resulting in " caries " in the jaws.

§ **178. Accidents.**—In many factories, various injuries occur in the working of machines, circular saws, fly-wheels, electric conductors at high tension, etc. Explosions may happen in the manufacture, and use of gunpowder and other explosives, in the combustion of fire-damp, and on many other occasions.

§ **179. Precautions against injuries in the course of a workman's employment.**—In order to reduce the injuries to health and accidents, arising from the risks mentioned in the preceding paragraphs, to the lowest degree possible, various statutory and police regulations have been drawn up. Frequently the carelessness or imprudence of the victim is the cause of the injury. In face of such occurrences it cannot be too strongly urged, that it is one of the duties attaching to every employment, to be informed completely of the dangers surrounding it, and to comply strictly with the rules of the factory, in regard to conduct and prudence.

Special care should be taken to provide sufficient light, air-space, and ventilation, to remove the dust arising in the course of work, as well as noxious fumes, gases, and refuse produced by it. Moreover, guards should be placed over machinery, and parts of machinery, contact with which, would injure the worker.

§ **180. Statistics of Sickness and Deaths in different Trades.**—To obtain a sure basis for the measures taken to prevent, or diminish the injuries to health in various trades, it is necessary to procure reliable statistical tables. By learning the character, and frequency of injuries to health, and accidents in any given branch of labour, we can judge of the danger of that labour, and of the

means to be adopted for lessening, or removing it. Different occupations can be compared with one another only, by selecting from each, as many persons as possible, possessing the same physical constitution, age, mode of life, housing, and keeping them under observation for years. It is not enough, however, to discover that there are less cases of sickness among 1,000 smiths, than among 1,000 shoemakers of the same age, during the like period, in order to infer from this, that shoemaking is less conducive to health than the labour of a smith. On the contrary, in such a comparison it should be taken into account that stronger persons, possessing greater powers of resistance, generally apply themselves to smith's work, than to the trade of shoemaking. Generally speaking, it may be regarded as settled, from our experience up to the present, that working in closed rooms, especially if filled with dust, causes more sickness, and, when joined to imprudent conduct, a shorter duration of life, than working in wholesome rooms, free from dust, and particularly than labour in the open air.

Occasionally the statistics of the mortality in individual callings, form still the most valuable criterion for estimating the dangers to health connecting with it. Thus, for males in England, between the ages of 25 and 45, the smallest mortality occurs among clergymen, gardeners, and field workers, and the highest among publicans and persons engaged in public-houses, file-cutters, miners in tin mines, brewers, &c. Consumption is very rare among sailors and country folk, but frequent among tailors and printers. Among males engaged in irregular employment, *e.g.*, peddlers, and the like, there is an appallingly high death-rate; but this may be explained by the number of weakly persons, unfit from bodily defect or illness for heavy labour, who are obliged to adopt these itinerary callings.

D.—Dangers to Health from External Influences.

I.—Injuries to Health from Weather and Climate.

§ **181. The causes and various classes of Colds, &c.**—Besides the circumstances prejudicial to health that have been mentioned in the preceding paragraphs, there are many external agencies independent of the relations, and mode of life of the individual man, which can produce illness. The influence of the weather on our health is unmistakable. In hot weather the skin presents a ruddy appearance, and moist qualities. The small skin-glands expanding under the influence of the heat, attract more blood: larger quantities of perspiration are exuded by the evaporation of which, heat is withdrawn from the body. The increased excretion of fluids by the skin results in a greater feeling of thirst, and a decrease in the secretion of urine; the urine contains less water, and hence exhibits a darker colour. As however, the diffusion of heat from the body is less than when the external air is cold, excessive accumulation of heat in the body is prevented by lessening the production of heat. Accordingly, a diminution in our desire for food, and a certain reluctance towards muscular labour is apparent.

In cold weather the skin pores contract, the exudation of sweat is smaller, the urine secreted is more plentiful and has a pale colour. The relatively large quantities of heat given off to the surrounding colder air must be replaced in the body. Accordingly, the craving for food increases

and generally certain kinds of food (fat, carbohydrates), are especially preferred. Heat is also produced by muscular action (movements of the limbs, &c.).

Although the body is capable of adapting itself to the temperature of its environment in the manner described, still, higher degrees of cold and heat are unpleasantly felt. Moreover, dryness and dampness of the atmosphere (*cf.* § 35), as well as variations in its pressure (§ 36), are felt by us. Lastly, wind and wet destroy our comfort. Such sensations lead us to suspect, that changes of weather are also causes of injuries to our health; moreover, experience teaches us, that persons engaged in occupations more particularly exposed to wind and weather, frequently suffer from the same diseases that appear in the case of other persons after a violent chill, or wetting. Such maladies are commonly called colds, and among them, in particular, all acute pains are popularly included, *e.g.*, acute and chronic rheumatism of the joints, muscular rheumatism, painful nervous disorders, such as faceache and sciatica. Many digestive indispositions, combined with diarrhœa, and laryngeal catarrh, are reckoned as due to cold. The last-mentioned, catarrh, mostly attacks the air passages, nose, throat, larynx, and the windpipe, with its branches; it may also lead to inflammation of the lungs, and of the pleura, and may involve the ears and eyes in joint suffering. These maladies are first exhibited as redness, caused by an increased blood supply, and in swelling of the mucous membrane, which, according to the part affected, produces sneezing, coughing, intolerance of light, dryness in the throat, hoarseness, etc. Sometimes an increase in the secretion of mucous takes place, which is plainly noticeable, in the mucous membrane of the nose and throat, and what is dry catarrh at first, becomes softened, and as a result, coughing becomes easier, and expectoration more plentiful. In light attacks the normal state of the

membrane may be restored by proper treatment of the person affected; frequently however, the symptoms of illness are accompanied by feverish pains, and other troubles, and sometimes even perilous disorders are developed from catarrh.

§ **182. Precautions against Chill.**—Although undoubtedly the indispositions mentioned above, are largely favoured by the influence of the weather, yet other circumstances are, as a rule, necessary to produce them. Hence, the exaggerated fear of wind, cold, and wet, and of every harmless draught—a fear partly based upon ancient medical theories—is often far-fetched, and is the occasion of injudicious conduct with many people. It is, of course, advisable to wear protective warm clothing in cold, wind, and heavy rain, and to exchange wet garments for dry as soon as possible; still precautions against chill should not prevent us remaining in the open air, or insisting upon adequate provision for the ventilation of closed rooms constantly occupied. The body is rendered effeminate by too warm clothing, or too anxious avoidance of cool air, and is deprived of the opportunity of becoming inured against the influences of the weather. Thus, the capacity of accommodating the body to changes of temperature ceases, and the individual becomes more easily the victim of a chill against which rational hardening of his frame would have protected him.

§ **183. Frostbites.**—Frostbites of various degrees whose lightest form is represented by the well-known and troublesome chilblains, form another group of maladies due to the influence of the weather. Their origin is often favoured by partial stoppage of the blood circulation, *e.g.*, under closely-fitting gloves, or tight boots. The parts of the body affected by severe frostbites become first, cold, stiff, and pallid like a corpse, blisters form on the skin, and finally

the frozen members become perfectly dead (*cf.* § 216). The portions of the body which are not moved during intense cold, are most exposed to the effects of frost, and hence the uncomfortable frosty sensation appears soonest on the nose and ears. Benumbing of the limbs occur especially among persons who lie down to sleep in the open air during the winter; death from freezing may result from the effects of very severe frost.

In cold weather therefore, we should keep constantly moving, and, above all, should not give in, in the open air, to the feeling of weariness and craving for sleep.

§ **184. Treatment of frostbitten persons.** —As the body as a rule, sinks into an apparently lifeless condition previous to actual death from freezing, it is our duty to at once make efforts to resuscitate those who appear to be frozen dead. The frozen person is accordingly brought into an unheated room, his clothes removed, and his body covered with snow, or laid in a bath of cold water, since quick warming would be injurious. The stiff body is then well rubbed with snow or with cloths, but care should be taken, as in all treatment of frozen persons, not to injure the limbs stiffened by the frost, and especially not to break them. When these become once more flexible, and the pallor disappears, and bodily heat returns, the patient is laid in an unwarmed bed, and there submitted to a course of artificial respiration, until he can breath regularly without assistance. An effort should also be made to pour tepid tea or coffee, and afterwards wine or brandy, down his throat. Only when consciousness, warmth, mobility and respiration are completely restored, can the now convalescent person, be brought into a warm room, and placed in a warm bed. Similar treatment is adopted for single parts of the body when frozen, as for the whole body. They are to be protected from being heated too quickly, and should be

diligently rubbed with snow or cold damp cloths, but not so roughly as to remove the skin, because in that case sores are formed, which take a long time to heal. The parts of the body affected should then be covered with lint or clean linen, after these bandages have been saturated with good oil, or smeared with ointment.

§ 185. Heat-Stroke, Sun-Stroke, Lightening-Stroke.—Excessive heat brings with it serious dangers to health since it may give rise to heat-stroke, which often terminates fatally. Attacks of this nature occur most easily when the air is almost motionless, and is saturated with moisture. The evaporation of sweat then proceeds slowly, and consequently the skin is not sufficiently cooled Also in dry atmospheres the skin exhalations become too small, if the water withdrawn from the body by perspiration is not replaced from time to time by drinking.

If in either of these cases, the air is too warm to effect a proper cooling of the body, and if the heat generated in the body is not diffused sufficiently, then the temperature of the blood increases, attains a height found only amongst persons suffering from fever, and finally produces the dangerous malady known as heat-stroke.

Heat-stroke most frequently attacks persons who undertake long marches in compact masses, *e.g.*, soldiers. Here much heat is produced by muscular exertion, while the surface of each individual's body is less accessible to cooling by the air, on account of the closely arranged ranks. The face of the person suffering from heat-stroke becomes red, his head becomes giddy, interest in conversation disappears, no answer is given to questions, and the man keeps marching with his comrades as if in a dream. If he, at this stage of the illness, is removed from the close files, and if the diffusion of the heat from the surface of his body is rendered easier, and the heat produced by

marching interrupted, the imminent collapse passes over quickly, especially, when refreshing drinks are supplied, and the skin sprinkled with water. But if the person attacked, continues marching in closed ranks, he loses consciousness, his pulse becomes weak and irregular, breathing only takes place superficially, and finally ceases, and the man dies in convulsions. In the German army, the officers, non-commissioned officers, and men are afforded an opportunity by frequently reiterated instructions, of recognizing and averting in time, the danger of an attack of heat-stroke.

In the case of an attack of heat-stroke, medical aid should be procured as quickly as possible. Until the doctor arrives, the invalid is to be treated in the same manner as persons who have swooned. It is especially necessary to restore the failing respiration by artificial means, and to apply ice or cold water bandages to the head, and if possible cool the body by bathing or sprinkling with cold water.

A malady allied to heat-stroke is sun-stroke, which may arise even with persons resting, and not engaged in muscular effort, by the direct radiation of a hot noonday sun on the head. The heating of the head causes a rush of blood to the brain, and in consequence, headache, giddiness, swimming before the eyes, nausea, vomiting, and faintness set in. In severe cases it may lead to convulsions, raving, and even death. Persons afflicted with sun-stroke should be brought into the shade as quickly as possible, and treated in the same manner as for heat-stroke.

Similar assistance should be given to persons struck by lightning. The latter are usually found in an apparently lifeless condition, but frequently recover under the influence of efforts made to resuscitate them. Sometimes loss of power of one of the limbs remains, but this mostly disappears under proper treatment.

§ **186. Climate and Seasons.**—Different dis-

eases have been proved to owe their origin to the climate, and to the season of the year. Thus phthisis (consumption) is found pre-eminently among people exposed to a severe climate, and other chest diseases, such as catarrh and inflammation of the lungs, occur most frequently among us in the winter and spring. Yellow fever, dysentery, and malaria are either exclusively, or to a very large extent, confined to tropical regions. Enteric fever, flux, and diarrhœa in children, are observed more frequently in hot seasons than at other times. Many diseases peculiar to foreign countries, run a comparatively mild course with the natives, while they are more serious for strangers travelling through the country who have not become acclimatised, or accustomed to the new climatic conditions. He who when changing climate does not adopt diligently a regular mode of life, or omits to adapt himself to the changed conditions, according to the advice of experienced and intelligent persons, renders his body susceptible to such diseases, just as, on the other hand, he who, in irrational, exaggerated zeal, suddenly changes completely, the habits necessary for his well being likewise becomes an easy victim to disease-germs.

II.—Infectious Diseases.

(a) In General.

§ **187. Nature and Manner of the Spread of Infectious Diseases.**—Climate and season, in spite of their undeniable influence on the origin of many diseases, are not the proper direct cause of the latter ; they only supply the conditions favourable to disease, either by promoting the vitality and growth of disease germs, or by

diminishing the power in the human body of resisting these germs. The essential cause of many diseases, and particularly of most that depend on climate and season, is to be sought in living microbes, which, penetrating into our body, taint or infect it. All diseases which owe their origin in this way to a communicable disease-germ, or "virus," are classed as infectious diseases.

The propagation of some infectious diseases, as measles and scarlet fever, is effected by the disease-germs, virus, or contagium, being communicated by one person to another. The germs of these "contagious" diseases, ordinarily find only in human and animal bodies, the conditions requisite for their continued existence. Other infectious disease (*e.g.*, malaria) possess a "virus," which acquires its infectious properties only outside the body, and are often confined to certain districts; these were formerly supposed to be due to poisonous exhalations, "miasmata," and hence were named "miasmatic diseases." It has not been definitely ascertained that contagious diseases are transmitted exclusively from one person to another, and that this is never the case with miasmatic diseases; still, the mode of propagation described, seems to constitute the most usual means of infection. Besides the diseases mentioned, there are others whose germs are both transmitted from person to person, and also thrive well outside the human body, propagate themselves, and when again conveyed to the man, are able to act as causes of disease. Instances of such diseases, which are also called "contagio-miasmatic," are Asiatic cholera and typhoid fever.

§ **188. Disease-germs.**—Scientists have succeeded in a number of infectious diseases, in obtaining the disease-germs in the form of certain minute micro-organisms, already referred to repeatedly. In each of these diseases, organisms, peculiar to each, were found in the blood, the

tissue, the juices, and the natural excreta of the body; and these organisms were invariably absent in the case of healthy, or differently affected persons. Scientists have succeeded in rearing some of these germs on artificially-prepared feeding-grounds, *e.g.*, meat soup, thickened by the addition of gelatine; and, by transferring these artificially-bred germs to animals, have been able to produce in the latter, the symptoms peculiar to the disease in question. Sometimes, by accident, imprudence, or experiments which courageous inquirers have made on themselves, it has been proved that artificially-bred germs produce sickness in men. These advances made by science, in the knowledge of disease, date only from the last few years, and are chiefly due to Herr Koch. Thus it has been shown how important a thorough investigation of the vital conditions of these micro-organisms is, in order to understand, and overcome infectious diseases.

The majority of the living organisms, hitherto described as disease-germs, are of a vegetable nature, and belong to the family of fissiparous fungi. Since many of them possess the form of short rods, they are called "bacteria," from the Greek word for rod. They appear sometimes singly, sometimes in groups, or arranged in the form of a chain. According to shape they are rod-like (bacilli), or spherical (cocci); some have a distorted form (vibriones); others the shape of a worm or screw (spirillis); many kinds possess a more or less powerful movement of their own; others are motionless. The propagation of bacteria is effected by fission (division); the young organisms thus produced grow to the size of the parent bacteria, and these, in their turn, divide themselves. This process is repeated so rapidly, that milliards of micro-organisms may be produced within a few hours from a small number. Many kinds form permanent structures or "spores," since, within the individual

bacteria, a spherical or egg-shaped body is formed, which is preserved in the fission of the parent organism, and is able to offer greater resistance to the effect of heat and cold, and also of many substances fatal to bacteria. If a spore of this kind, which is somewhat similar to the seed of a plant, is brought under conditions favourable to its vitality, it grows to the size of the parent bacteria. Hence, disease-germs, which otherwise can thrive only inside the body, may retain their capacity for development outside the body in the shape of spores, and may reproduce themselves as soon as they penetrate into another body. All bacteria are so small that they can be recognised only when greatly magnified, and nearly all are practically colourless ; they are distinguished, however, in great part, by the fact that they can absorb, and tenaciously retain certain colouring substances. Therefore, if a fragment of animal tissue, coagulated blood, etc., is treated with such a colouring substance, and then washed, the bacteria alone remained coloured in the colourless tissue. In this way the bacteria can be more easily recognised under the microscope, than in their natural condition.

The bacilli multiply in certain liquids to such a degree that they are visible to the naked eye as a cloudy discoloration. On a solid nidus (substances or fluids on, or in which they grow), they form by their growth accumulations, each consisting of millions of single organisms, but which appear to the unaided eye merely as minute drops, specks, knobs, or slight protuberances. For instance, if a boiled potato is cut in two, and exposed for some minutes to the air, and then placed under a glass shade, such colonies of bacilli may be observed on the cut surface after twenty-four hours, which have been developed from single bacilli deposited by the atmosphere.

By their propagation the bacilli alter the composition

of their nidus, as they withdraw from it certain substances necessary for their structure, and thus numerous and varied chemical combinations may arise. In this way they cause many processes of fermentation and decomposition, by action similar to the yeast fungi already mentioned. Many species of bacilli also separate poisonous substances from their nidus, which may have, even in very small quantities, fatal effects on the human body; other bacilli contain

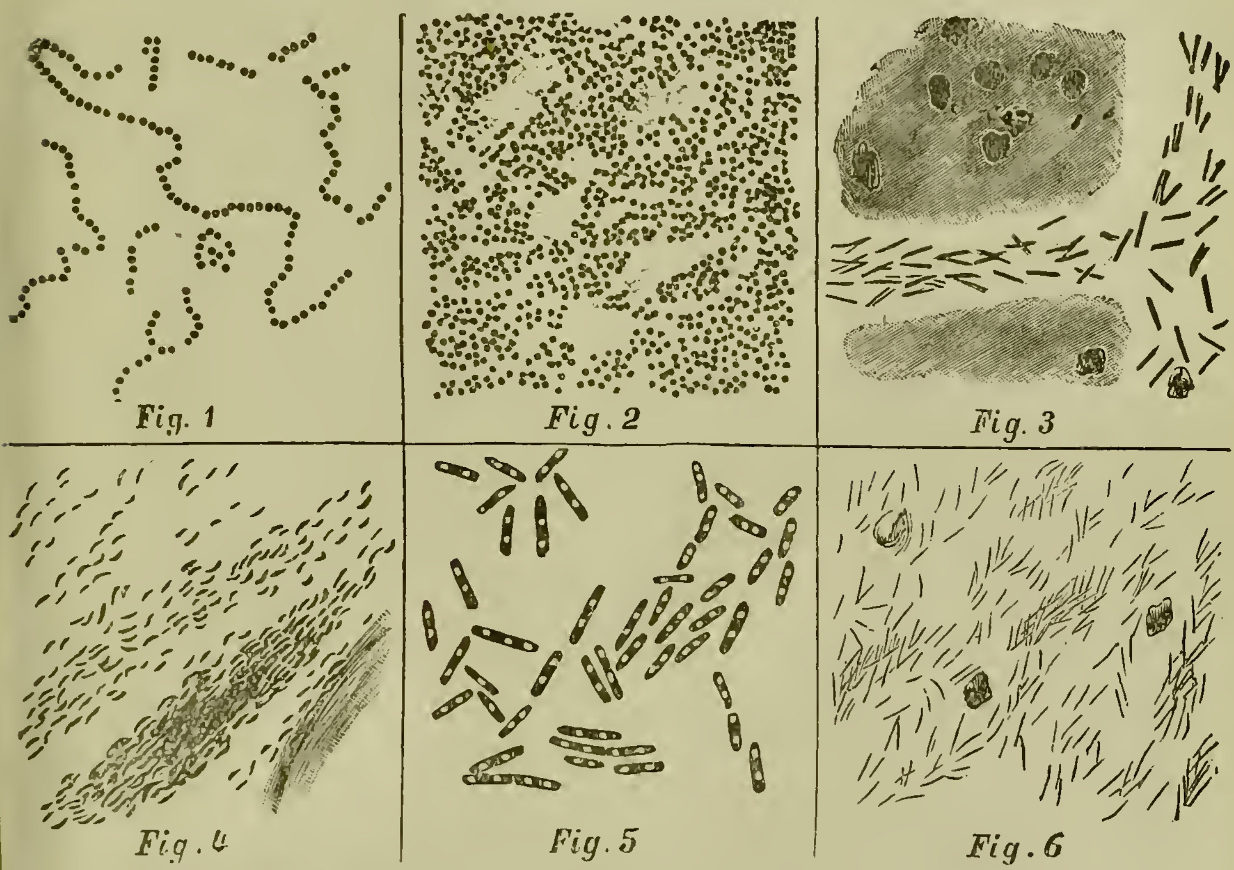


Fig. 41. Diagramatic Representation of Bacilli (greatly magnified).
1. Cocci in Chain Form. 2. Cocci in Groups. 3. Bacilli in a Capillary Vessel. 4. Comma-Bacilli. 5. Bacilli with Spores. 6. Very Fine Bacilli.

poisons themselves. Thus by the nature, and vital functions of bacilli, is explained the injurious effect on the human system peculiar to many of them. The illnesses produced by bacilli originate according to our present information, either in the destruction of the tissues serving as their nidus, or in the poisonous substances separated by them, or in their own poisonous action. Some infectious diseases are

ascribed to the activity of certain animal micro-organisms. However, among the incalculable number of micro-organisms only relatively few species are injurious to health. The body permanently contains innumerable small living organisms, which are partly harmless spores, and partly assist in certain bodily functions, *e.g.*, digestion. Other germs are unable to exist inside the body, and perish as soon as they are introduced with food or otherwise. Lastly there are also micro-organisms, which are not properly disease producers, but which may be injurious to health if they pass into the body in large quantities, or have acquired abnormal qualities; among these are included some putrescent fungi, and many bacilli present even in the healthy intestines.

§ **189. Preliminary Conditions of Infection.**—The disease germs require certain predisposing conditions in order to be capable of producing their peculiar effects. The frequent appearance of certain diseases in places (endemics), or the sudden spreading of such diseases, or their subsequent extinction, and the immunity of other districts, cannot always be explained exclusively, by the presence, absence, or introduction of the corresponding micro-organisms. The numerous special circumstances, not yet closely investigated, which promote, in endemics, or epidemics, the spread of disease germs—(1.) at certain times; (2.) in certain places; (3.) among certain persons or classes of persons, are provisionally described as (1.) temporal; (2.) local; (3.) personal "predispositions." A "temporal" predisposition is afforded by the action of the weather, such as abnormal heat, atmospheric moisture, etc., which temporarily provides conditions favourable to the spread, and virulence of the disease germs. Many epidemics find a "local" predisposition, among others, in the neighbourhood of swamps, in unhealthy or over-

crowded dwellings, in a bad water supply, and in defective arrangements for the removal of refuse. The importance of individual or personal predispositions is very great. It is observed in times of epidemics, that only a limited portion of the population exposed to the danger of infection suffer, and some families are unusually susceptible to certain diseases of an infectious nature.

The pre-disposition to many illnesses, *e.g.*, phthisis, is transmitted from the parents to the children, and grandchildren. Therefore, although in the appearance or absence of illness, chance plays a great part; and though the immunity of certain persons, such as doctors during cholera, and typhus epidemics, can to a great extent be explained by their taking proper precaution, still, we must assume an immunity in many men, and a predisposition in others, towards infectious diseases. The immunity from an infectious disease can be innate, or be acquired, but may be lost again under certain conditions, *e.g.*, in consequence of hardship or want of nourishment.

It is well known that many persons, after surmounting an infectious disease, such as smallpox or measles, are not attacked a second time by the same disease.

§ **190. Preventive Measures against Infectious Diseases.**—The efforts directed towards warding off infectious diseases, had already led to splendid results before the producers of the diseases were discovered in the micro-organisms. In past centuries epidemics wrought far greater devastation than at present. In the fourteenth century the black death carried off twenty-five millions, that is about a quarter of the entire population of Europe, at that time; smallpox and typhus alone, regularly caused more deaths, than are now caused by all infectious diseases taken together. In particular, the number of cases of sick-

ness produced by infection, has palpably decreased where attention is paid to the requirements of hygiene.

In the Prussian army, in the year 1869, 22,218 men were attacked by infectious disease, but since that time such cases have decreased so much from year to year, that ten years later, the number was only 11,467, and after the expiration of another decade, it had fallen to 4,695 annually, although the strength of the army has been considerably increased since 1870.

The city of Munich was formerly regarded as very unhealthy, for, between 1850 and 1860, 213, in 1858 as many as 334, and between 1867 and 1875, 130 per 100,000 of its inhabitants, annually died of typhoid fever.

Upon the advice of Pettenkofer, it was decided to improve the sanitary arrangements of the town; provision was made for suitable removal of the refuse; private slaughter-houses were suppressed, and good drinking water supplied by Artesian wells. Since then, the number of fatal cases of typhoid has constantly decreased. In the interval from 1876 to 1878 only 42 cases on an average, and in 1892 less than 3 per 100,000 inhabitants, died from this disease. Similar results, in respect to the decline of infectious disease, have followed the sanitary improvements effected in many other German towns, *e.g.*, Berlin and Dantzig.

As the power of resisting infection in the individual, is strengthened by proper mode of life, and suitable nourishment, so an efficacious means of combating infectious diseases, is found in the healthy arrangement, and government of communities.

Nevertheless, man is not sufficiently protected against infection without additional safeguards.

§ 191. Resistance to Infectious Diseases. —In the section on Commerce we have already described the means adopted for preventing the spread of infection

from place to place, and from country to country. In order to be able effectually to suppress an epidemic that has broken out in a town or country, it is necessary that every single case of it should be promptly reported to the authorities ; furthermore, each case should be supervised, so as not to become the starting-point of further sickness. The essential means employed for these purposes, are (1) The duty imposed on doctors, the relatives of the sick, or other persons responsible for them, of notifying the illness. (2) The isolation of the sick (and if necessary, of persons having intercourse with him), from the healthy population. And (3) the destruction, or disinfection of the disease-germs in the excreta of the sick, in their linen, and clothing, and in all objects to which the infectious matter might adhere.

For destroying disease-germs the best means is burning, but such an extreme measure is resorted to, only when disinfection would be too costly in comparison to the value of the tainted object. A disinfecting process should be effective, cheap, harmless to the objects treated by it, and free from danger to the persons entrusted with its execution. Disinfection is effective if it destroys the infectious matter, or renders it innocuous—a goal that can be attained only under the guidance of skilled persons.

The following processes are used for disinfecting :—

1. Heating in Steam.—For this process are used either moveable, steam-producing apparatus, which are brought from place to place like locomotives, or stationary boilers, erected in special disinfecting rooms. Steam apparatus, from which a reliable result is to be expected, should be examined by competent persons, and attended to by trained workers. When well-constructed, and properly-fed ones are used, the steaming process destroys disease-germs with great certainty, and possesses the advantage of not injuring most objects. However, leather articles, furs, indiarubber

goods, glued, polished, or veneered articles, some metal wares, and many kinds of furniture are rendered valueless by it, and hence should not be disinfected in this way. The finer articles of clothing require mending, and pressing after the action of the steam. Cloth or linen garments, which have been defiled with blood, matter, human excreta, should be washed before being place in the steam apparatus, or otherwise permanent stains, are usually left behind. Large objects disinfected by steam, are benefited by being protected from the water deposited during cooling, by means of coverings of sacking, etc.

2. **Boiling**.—The objects to be disinfected are placed in boiling water, to which some soda has been added. The process is easily carried out, and when continued long enough, produces reliable results ; however, it is inapplicable to many objects. It is most suitable for underclothing, small metallic objects, utensils, etc.

3. **Chemical Treatment**—(*a*) **Solution of Carbolic Soap**.—To a solution consisting of three parts of soft soap (black or green soap), and 100 parts of water, five parts of commercial carbolic acid are added, while the solution is kept constantly stirred. Linen and other suitable materials are steeped for a long time in the solution ; wooden articles, floors, the walls of rooms, shoes and other leather articles are washed with it. Sometimes the soap solution without the carbolic acid is sufficient. The smell caused by the acid is removed from the disinfected objects by washing or airing.

(*b*) **Whitewash**.—This is prepared by mixing one part of broken, well-burnt lime with four parts of water. It is best carried out in the following manner :—In the preparing-vessel only a small portion of the water is first poured ; the lime is added, which absorbs the water, and in a short time is reduced to powder, steam and heat

being thereby produced. Then the rest of the water is added, while the contents are kept stirred. The disinfecting fluid prepared in this way, should be kept in well-closed vessels, and be shaken before being used. In handling whitewash, care should be taken that none of it is allowed to come in contact with the eyes, as it is a corrosive fluid, highly injurious to the visual organs. Whitewash is pre-eminently adapted for disinfecting the excretions of the sick. When thoroughly mixed in equal proportions, with the latter it kills the disease-germs or micro-organisms contained therein in a short time. It is also used with advantage for disinfecting the sick room, by washing or painting, the walls and floors admitting of such treatment with it, and repeating the process after a short interval.

4. Beating, Brushing, Airing, Sunning.— This treatment is applied to objects that would be rendered useless by boiling or wetting, as well as to objects that are unsuited for disinfection by steam, *e.g.*, many upholstered articles. The process suffices for the removal of certain disease-germs; however, it is generally not to be relied on.

5. Other Means.—Some further disinfecting processes are applied according to the circumstances of the case. Thus, a number of chemical substances, *e.g.*, corrosive sublimate (a mercurial compound), thymol, chloride of lime, and of zinc, are useful means of disinfection in certain cases. Some of them are specially suited for destroying diseased matter on the hands, and other parts of the body, but in such cases a thorough soap-lather with a brush should precede disinfection. The whole body is most effectively disinfected by a bath with a plentiful use of soap. Infectious substances are removed from carpets, by rubbing them with bread crumbs, which should be burnt after being used, or the carpets, are entirely removed, so that the walls may

be whitewashed. The joinings of the boards in the floor should be sprinkled with the disinfecting fluids ; sometimes it is necessary to remove the entire dust from under the floor.

Unfortunately, some unreliable modes of disinfection are still largely employed. Among them are, the treatment of the object with sulphate of iron, or of copper, or with sulphuric acid. Even fumigating with chlorine gas, and spraying with diluted carbolic acid, are often insufficient to attain their object, because the disinfectants are not employed in sufficient quantities. The manner, extent, and duration of disinfection should in every case be decided by an expert, preferably by the doctor, and the execution of the process should be placed under medical supervision, so far as it cannot be entrusted to special disinfecting works. Establishments of this kind are to be found in many large towns, also in some country districts. The skilled staff repair with the necessary means to the sick dwelling in order to disinfect it, and the immovable objects to be found therein. Clothing, bedding, furniture and utensils from the sick room, and other movable objects are taken away in well-closed wagons, and brought back to the house twenty-four hours later, after complete disinfection.

Abuse of disinfection frequently occurs, especially in times of epidemics. Travellers, and their luggage are sprinkled with disinfectants, the streets and various objects, which cannot be remotely suspected of being infected with disease-germs, are sprayed with the same fluids. Apart from the fact that such proceedings are inconceivably uncomfortable, and occasion a useless expenditure of disinfectants, they have the especial drawback of giving the people the erroneous belief that they are safeguarded from the infection. Thus, the really effective means for prevent-

ing the spread of disease are easily overlooked, and, relying on the efficacy of the disinfectants, cleanliness is neglected, though it is in every case more beneficial than inefficient disinfection.

§ 192. Course of Illneses arising, from Infection.—The most important requisite for resisting the spread of contagious disease rests on the prompt identification of each individual case. Accordingly it is necessary to be informed how these diseases, usually progress, and the manner of their entrance into the human body. Although infectious diseases differ in many ways from one another in this respect, still they have, much in common as regards their origin, external symptoms, and course of development.

The disease-germs find their means of ingress into the human body through the larger openings in the body, especially through air, and food passages (nose and mouth), or through sores, often through scarcely visible abrasions of the skin, and sometimes even through the pores of the skin. Many germs induce changes at the point of ingress, or at least within that organ into which they first pass ; others, migrate in the course of the lymph, or blood, in order either to multiply there, or, carried on by the circulation, to settle themselves in other parts of the body. In every case there follows, after the ingress of the germs, a period of time required for their multiplication, and for the formation of the poisonous matter, during which the infected person is still apparently healthy ; this period is called, the "stage of incubation" of the disease. Towards the end of this period, which has a different duration for each infectious disease, premonitory symptoms of the disease exhibit themselves, such as weariness, loss of appetite, general painful sensations, a feeling of discomfort, etc. Next ensues the out-

break of the disease, sometimes accompanied by vomiting, chill and shivering, amounting even, to a chattering of the teeth.

§ **193. Fever.**—A loss of health known as fever, is peculiar to many infectious diseases. This is the external expression of an increased metabolism (of a greater combustion in the tissues of the body), and forms in many cases, an auxiliary to nature in resisting the disease-germs, and in destroying their poisonous matter. The most prominent characteristic of fever is, the measurable increase in the temperature of the body (*cf.* § 22). A blood-heat raised to 39·5°C. corresponds to a moderate fever, a still greater increase to high fever. The frequency of respiration is increased in fever, as also is the number of pulse beats, corresponding to a greater activity of the heart; the patient suffers from thirst, perspires sometimes, and evacuates only small quantities of a highly red urine, which often leaves a layer of deposit. The sick person complains of headaches, giddiness, and vertigo, suffers from delirium, talks wildly, clutches distractedly about him, and wishes to leave the bed. If they are not well watched in such a condition, there is a danger of their injuring themselves, falling out of bed, jumping from the window, etc.

In many infectious diseases the fever remains at almost the same height for several weeks; in others the temperature of the body sinks regularly about 1°C. in the morning, and rises again in the evening; in others the fever disappears after several hours, or in a few days. Increase, and decline of the fever sometimes takes place gradually, sometimes quickly. A sudden decline of the fever, generally accompanied by perspiration, and refreshing sleep, is called a "crisis."

Infectious diseases are either followed by convalescence, or they leave behind, after having run their courses, disorders in the functions of special organs, after-ailments,

tedious loss of strength, permanent infirmity, or they end with the death of the person attacked.

(b) Special Infectious Diseases.

§ **194. Acute Eruptive Diseases.**—Infectious diseases, which display similarities in their external symptoms, their mode of spreading, and their course, are usually combined in groups. Thus measles, German measles, scarlet fever, small-pox, chicken pox, and spotted fever are collectively described as acute eruptive diseases, because all are quickly (acutely) developed, and are distinguished from others by the appearances of eruptions on the skin. The eruptive diseases named, are infectious; they spread themselves usually by direct communication from the sick, but are also disseminated by healthy persons, who have come in contact with the patient, or by the garments, underlinen, etc., worn by the latter. The infectious matter of some of them, likewise adheres to the sick rooms, and thus may prove dangerous to later occupants. Each of these diseases possesses in addition individual characteristics.

§ **195. Measles and German Measles.**—In measles, in ten to fourteen days after infection has occurred, an eruption of the skin, in the shape of, irregularly round, and somewhat raised, red spots, usually appears along with moderate fever. This eruption is first exhibited on the face, and then spreads quickly over the neck, trunk and limbs, so that the body appears as if spotted with red. Whilst these changes are proceeding, catarrhs develop themselves in different mucous membranes, the eyes become bloodshot, and the lids become half closed ; light is avoided as unendurable, and sniffling, coughing, and hoarseness are among the ordinary symptoms. When the outbreak has reached its maximum, the fever declines, and whilst the rash

gradually disappear, the epidermis is renewed, by peeling off. Measles but seldom attack the same person twice during his life. It occurs in Germany usually as a children's disease, and generally without fatal effects, since very few persons escape infection before arriving at maturity. Often games played in common, kindergartens, and schools form the occasion for its transmission. In case the sickness is introduced into a family it often attacks all the children one after the other.

Although measles is not usually fatal, especially among children, it is advisable that a physician should be called in, even for light attacks, and that the patients should never be considered as restored to health, sooner than four weeks after the appearance of the disease, for, by imprudent treatment, consequences, sometimes of a serious nature, arise out of the catarrhs accompanying the disease, viz., lung disease, with affections of the eyes and ears. The dissemination of measles can be prevented by perfect isolation of the patients, and by disinfection of their excretions, as well as of the linen, clothing, and other articles used by them. Generally the brothers and children of patients suffering from measles are excluded from the schools by the authorities. When this disease breaks out generally among the pupils, it may be necessary to temporarily close the class, or school altogether. However, the measures taken to prevent the spread of measles are generally too late, because the disease is very infectious in its early stages, before the appearance of the rash places its character beyond doubt.

German measles is a disease very similar to ordinary measles, and, according to the opinion of many physicians, is only a variety of it. It is distinguished from the latter by its milder course, especially by a subsidence, or absence of catarrhs.

§ **196. Scarlatina.**—On an average, scarlatina begins from four to eight days after infection, and is usually accompanied by high fever, whose commencement is signalised by shivering, or vomiting. The patients complain of swelling of the tonsils, followed by difficulty in swallowing; soon there spreads over the body, usually beginning on the trunk or legs, a somewhat uniform, raspberry-coloured rash, and the tongue, when not covered with a white coating, also exhibits a raspberry-red colour. After several days—sometimes after only a few hours—the rash begins to decline, and at the same time, in favourable cases, the fever disappears. The skin finally undergoes a process of scaling, lasting for several weeks. In no small number of cases of scarlatina the rash is not completely developed on the surface, and then the presence of the disease can only be inferred from the course of the illness, and from its resemblance to other cases of scarlet fever.

Scarlatina should always be regarded as a very serious illness; sometimes death occurs even in its early stages; but more frequently it becomes fatal, through the diseases which accompany, and follow it. A concomitant disease to be often looked for is, an affection of the tonsils similar to diphtheria. As resulting diseases, affections of the ears, rheumatism, purulent inflammations of the joints, and of the lymphatic glands in the jaws, inflammation of the kidneys, sometimes appear. The latter occurs usually along with dropsical swelling of the skin of the face or legs. The doctor may infer its presence, from the presence of albumen, and cellular elements in the urine.

Having regard to these dangers, the scarlatina patient must be constantly watched and treated, by physicians and especially should be protected from injurious external influences (cold, &c.), for several weeks, in a uniform temperature. Imprudent conduct, *e.g.*, getting up too soon, favours

the development of after-diseases, which have often caused death or general debility after apparently light attacks. Scarlatina mostly attacks children and young persons, but sometimes seizes adults. Having regard to the frequent serious course of the disease, every precaution should be taken to prevent its spreading, and greater success may be counted upon by attending to such efforts than in the case of measles, for as scarlatina attains its maximum power of contagion only after full development, the preventive measures are less liable to be late than with measles. The patients should be strictly isolated. With regard to preventing further spreading of the disease through schools, special measures are to be adopted; and the disinfection of the patient's excreta, of the articles used by him, and of the sick-room appears all the more indispensable, as it is beyond doubt, that the infectious matter can be transmitted by inanimate objects such as letters, and adheres for a long period to localities.

§ **197. Smallpox**.—Smallpox, as a rule, breaks out in from ten to thirteen days after infection. The illness begins with a high fever, great depression, pains in the head, difficulty in swallowing, and shooting pains in all directions. After a few days red pimples show themselves, with an abatement of the fever. They appear first on the face, then on the remaining surface of the body, and on the mucous membranes, and from them peculiarly-shaped pustules, containing a transparent liquid, develop themselves. During the following days the liquid contents become turbid, and when about ten days of the illness have elapsed, begin to assume a purulent character, accompanied by a fresh increase of the fever. Within about twelve days these pustules begin to dry up, with a decline of the accompanying fever, and scabs are formed, which afterwards fall off, leaving behind

radiating pock marks. When the course of the disease is uninterrupted, six weeks elapse between the contraction of the disease, and full recovery.

Smallpox often results fatally, especially when it appears in the form of black pox—*i.e.*, when the contents of the pustules become dark in colour from an admixture of blood, or when affections of the brain, throat, lungs, or kidneys supervene. The outbreak of pustules in the eyes may result in complete or partial blindness: their appearance in the organs of hearing may occasion total or partial deafness.

A somewhat more tedious, and less violent form, than the ordinary or true smallpox above described, is the false pox, otherwise called modified or varioloid pox. The mild aspect of this form should not however, be the occasion of carelessness in reference to the preventive measures to be taken against its spreading, as the infection caused by it is the same as that of the true smallpox.

Smallpox belongs to the most dreaded of infectious diseases: frequently it carries off more than half of those attacked, and leaves behind it, as a legacy to those who have escaped death, general debility and infirmity. Moreover, the infection is exceptionally easy of transmission, as contagion is communicated not only from one person to another, but is also conveyed by the objects touched by the sick persons, and even by currents of air. In the last century one tenth of the children, and large numbers of adults fell victims to smallpox. In vain were attempts made to restrict the ravages of the disease by isolation of those attacked. By means of inanimate objects, incapable of disinfection by the measures then in use, and through the intercourse of healthy persons with the patients the contagion continued to be carried from the sick-rooms, and caused the most devastating epidemics.

§ **198. Vaccination.**—Shortly before the end of the eighteenth century, the world received in vaccination, a weapon by which it was to overcome the terror of this epidemic. In the year 1798 the English physician Jenner published the fact, already known for a long time, and investigated by him in his home in Gloucestershire—namely, that an inoculation with the contents of the pox-like pustules sometimes appearing on cows' udders, the so-called "cow pock," affords a protection against the attacks of genuine smallpox. His investigations were soon confirmed. It was afterwards shown however, that the protection acquired by inoculation gradually decreases, and hence, if the body is to remain permanently safeguarded against smallpox, the protection must be renewed by a repetition of the inoculating process.

For the purposes of vaccination, the contents of the cowpock produced in calves by inoculation (animal lymph), is almost universally used in Germany, while formerly a preference was shown for inoculation by human pock (humanised lymph). The latter process has been chiefly abandoned, because it was feared that with such lymph, not only the vaccine but also chance diseases of the person from whom the lymph was derived, would be communicated. This danger is excluded by using animal lymph. The strict supervision of the production of lymph, and of the institutions formed for that purpose, partly under municipal control, is a guarantee that the lymph is derived from healthy animals.

The upper arm is usually selected as the vaccinating spot. The development of the pock follows in five or six days after vaccination; sometimes accompanied by fever, and frequently with reddening and swelling of the neighbouring skin. Children that have been vaccinated are often

somewhat out of sorts at this time, just as when cutting their teeth, but they soon regain their vivacity.

In the treatment of vaccinated persons, chief attention should be given to cleanliness, and to prevent the spot vaccinated from becoming sore. The incisions are closed in a few minutes by a light scurf, and then remain permanently protected from impurities, since the pustules produced afterwards do not open, but dry up and scab over. As a rule, it is only necessary that the spot selected should be carefully washed with water and soap, before vaccination, and should be subsequently kept covered with clean, not too tight, garments; in the case of children, they should be kept clean, and should be thoroughly but carefully washed once a day, naturally avoiding the pock. Children also should be prevented from scratching the spot vaccinated, or the pock as it develops, and also from moving their arm too vigorously. If the spot vaccinated festers in spite of these precautions, a bandage should be placed on it by a skilled hand. Covering the sore with dirty bandages, or smearing it with rancid, dirty fat or ointment, &c., brings an infection of the wound in their train.

In exceptional cases after vaccination, skin eruptions, or inflamed sores have appeared, such as are associated sometimes with superficial wounds of every kind. These symptoms are almost always to be ascribed to neglect in the treatment of the person vaccinated, and can be avoided by a little care. It need not be a cause of surprise if, other diseases of childhood set in some days after vaccination: it is on the contrary, scarcely conceivable by the initiated that an attempt should be made to infer "vaccination-disorders" from such chance coincidences.

Smallpox has become an almost unknown disease in Germany, since the introduction of vaccination; while, on the other hand, it annually causes considerable loss of life

in the neighbouring countries in which vaccination has not been carried out to the same extent, *e.g.*, in many districts of Austria, and Russia, as well as in Belgium, and France. The few cases of the disease still observed in Germany, are almost always imported from foreign countries, and this explains why the great majority of such cases occur in seaports, and frontier towns. Thus, between 1886 and 1892, out of 891 fatal cases of smallpox in the whole empire, 833 took place in seaports and frontier towns. Despite the protection afforded to the people by vaccination, isolation of persons attacked, and careful disinfecting measures should not be omitted in cases of smallpox, with vaccination, of unvaccinated children, and adults who have not been revaccinated.

§ **199. Chicken-pox.**—Chicken-pox or "varicella," is a disease different from the true, or spurious smallpox. It is also contagious, generally attacks children under ten years of age, and reveals itself by the appearance of small pustules on the face, the arms, and other parts of the body, accompanied by light fever. The rash disappears in a short time, usually without leaving any scars behind, and the disease, as a rule, runs its full course in a few days.

§ **200. Spotted Fever.**—Spotted fever, or spotted typhus, is also frequently described as hunger, or war, typhus, because the disease has repeatedly developed, and spread in times of famine, among the starving population, or in time of war among the troops, weakened by privations and hardships. In Germany, during the current century, the disease has, in an epidemic form, especially visited Upper Silesia, and East Russia; it has also been observed in other parts of the empire, notably in certain districts of Central Germany.

The illness runs its course with high fever, and is distinguished by a rash which appears after the first days

of sickness, and resembles the rash of measles, but is less diffuse, and usually spares the face. The consciousness of the patient is nearly always clouded, the fever lasts about two weeks in favourable cases : still one-sixth or one-seventh of the persons attacked, succumb to the disease. Sometimes, diseases that make their appearance subsequently prove fatal.

Spotted fever is one of the most easily communicable diseases : the contagious matter can both be transferred from the sick to the healthy, and be introduced by inanimate objects. The disease is most frequently spread by roving persons, pedlars, beggars, &c., its dissemination is to be resisted by isolation of patients, and disinfection.

§ **201. Remittent Fever.**—Spotted fever, remittent fever, and typhoid fever (although the three diseases are throughout distinct from one another), are combined by many writers in a common group called "typhus" diseases.

Remittent fever or remittent typhus is produced by the action of a well known bacillus having a spiral form ; it is not a common disease, but is easily communicated, and exhibits itself in repeated attacks of high fever, each lasting from five to six days. The spread of remittent fever is caused in the same way as spotted fever, frequently by wandering persons, and especially in unclean inns : the preventive measures are the same as for spotted fever.

§ **202. Typhoid Fever.**—Thanks to the improvements in the public sanitation in many large German towns in which formerly numerous cases of illness and death, and even widespread epidemics, were caused by typhoid, this disease has become rarer ; however, it prevails largely in the country and in many towns. In the fifteen years from 1877 to 1891, 41,616 persons died from typhoid

in the 200 large towns of Germany, being a yearly average of 2,714 deaths for the whole empire ; still, since 1877, there has been a steady decline in the number of deaths from typhoid, *e.g.*, in the five years from 1877 to 1891, the average was only 2,269 annually, and in 1892 the number of deaths was only 2,054, although there has been a great increase in the urban population during the same period.

The interval between reception of the infectious substance, and the outbreak of the disease amounts in many cases to fully four weeks. Then the disease begins with depression and weariness. A fever, moderate at first, increases from day to day, generally attains a considerable height at the end of a week, and fourteen days later gradually abates. Towards the end of the fourth week in the normal course the fever, and with it, the disease proper is usually over, but the patient still requires a long time, often a period of several months, before he attains complete restoration to health. Concomitant, and subsequent diseases, such as inflammation of the lungs, suppuration of the skin and joints, pains in the ear, nervous disorders, even mental diseases are frequently associated with typhoid, and cause death, or the development of infirmities and debility. The disease itself may endanger life, *e.g.*, by exhausting hemorrhage from the bowels.

The most noteworthy changes produced in the human body by an attack of typhoid consists in the formation of ulcers on the mucous membrane of the small intestines. Moreover, swelling of the spleen is always present, and besides, a more or less pronounced delirium, catarrhs of the respiratory, and digestive passages, especially diarrhœa, usually complete the form of the disease Its common name of "nervous fever" is to be ascribed to the nervous symptoms.

Patients suffering from typhoid should not fail to obtain medical treatment. Where regular visits from the doctor

are impossible, or where domestic, or business relations interfere with their nursing, treatment in hospital, which is very beneficial to such patients, is recommended.

In nursing typhoid patients, especial care must be taken that they do not receive solid food before the doctor allows it. Compliance, caused by false pity, with the craving of the patient, tormented by a feeling of hunger during convalescence, has often been severely punished, as such diet, being difficult of digestion, has led to evil results, even to rupture of the peritoneum, which, at the ulcerated spots, during healing, is reduced to the thinness of paper.

Thus, the frequently observed relapses of the disease, are often connected with non-observance of the directions given as to the diet of the patients.

The typhoid germs leave the body of the patient along with the excreta, and easily pass, even with careful watching, to his linen and bedding ; sometimes the excretions occur involuntarily.

From his linen the infectious germs may spread to his hands, and next to all objects touched by him, such as clothes, food and utensils ; may thus find occasion to infect relatives, nurses, physicians, and other persons who do not carefully observe the regulations necessary in the intercourse with the patient, The patient's linen must be disinfected as soon as possible after use, and the sick room and its furniture after the close of the illness. The excreta of the patient should never be discharged or removed without previous disinfection. The non-observance of this latter regulation is a frequent cause of epidemics of typhoid and, in fact, those houses and towns are especially smitten with this disease in which the removal of refuse, and the water supply do not comply with sanitary requirements.

Where unobjectionable water is not at hand it is advis-

able on the appearance of the disease, to boil all water used for domestic purposes, but, in any case, to drink only boiled water.

§ **203. Gastric Fever, Catarrh of the Stomach and Intestines.**—Unfortunately the execution of the preventive measures just described, is omitted in many cases of typhoid, partly from ignorance, or neglect, partly because the disease, on account of its mild symptoms at first, is not described as typhoid, but as gastric fever. By this latter term is understood a feverish, stomach catarrh, which is produced by unhealthy, putrid, or excessive food, and exhibits itself by loss of appetite, constipation, headache, pain or a feeling of oppression in the abdomen, foul smell from the mouth, hiccough.

Typhoid is sometimes mistaken for intestinal catarrh, which arises from similar causes as gastric catarrh, and is characterised by diarrhœa.

The disordered conditions of the digestive organs just mentioned may also appear in an apparently mild form, and without fever, but may nevertheless, take a serious turn, and lead to injurious consequences, especially by improper conduct on the part of the patient. Hence it is advisable to call in medical advice in such indispositions, and even before the arrival of the physician, to make the diet conformable to the principles indicated further on.

Diarrhœa is produced from similar causes as the last mentioned illness, by simultaneous disorder of the stomach and intestines. It often runs its course in the form of a slight indisposition, without leaving behind any after effects, yet it frequently appears more severely, endangering health, and is then called cholera nostra. Complaints of this kind are specially observed in large numbers among children of tender years, and in the summer time, particularly in towns, causing many deaths among young children.

A cause acting simultaneously on several persons, *e.g.*, the eating of putrid food, has sometimes resulted in a number of persons being seized with cholera nostra; still the disease lacks the peculiarity of spreading from the sick to the healthy, by the immediate or mediate transmission of infection. It is thus distinguished from one of the most dreaded epidemics (with whose course, cases of severe diarrhœa possess much similarity), namely Asiatic cholera.

§ **204. Cholera.**—Asiatic cholera, which has long been indigenous to Asia, especially to India, has only made its appearance in Europe during the present century, when it either made its way as a migratory epidemic through Persia to Russia, and the Balkhan Countries, or was imported by seafarers into sea-ports. It then produced epidemics in many European countries, which disappeared after a few years, in order to break out again upon renewed importation. As an instance of the extent of the devastations caused by this epidemic, it may be mentioned, that the cholera epidemic of 1892, in the Russian Empire, caused 550,000 cases of illness, and 260,000 deaths, and in the small town of Hamburg, caused in a few weeks 18,000 cases of illness and 8,000 deaths.

The course of a severe case of cholera is somewhat as follows:—The disease appears with violent vomiting and diarrhœa, several hours, but as a rule some days, after the reception of the cholera germs. The excretions becoming more frequent, soon acquire a colourless appearance, similar to thin pea-soup, or the water poured off boiled rice, and thus withdraws such considerable quantities of fluids from the body, that the secretion of urine ceases, the skin becomes dried, and may be raised in large folds, only slowly returning to their normal level. At the same time painful muscular cramps set in, especially in the calves of the legs; rapidly increasing exhaustion, the patient

becomes entirely indifferent to everything that occurs with, and around him, and often, after a few hours, death ensues in this condition. In less severe cases, vomiting ceases after some time, the excretions become gradually less frequent resume their normal character, and full convalescence ensues in from two to three weeks.

Patients who survive the attack of cholera proper, frequently succumb to the so-called cholera typhoid, a feverish condition, accompanied by delirium, which often develops at the close of the original disease.

The German Commission was sent in 1883 to Egypt, and India to investigate this epidemic. Herr Koch, as head of this Commission, succeeded in discovering the cholera germ in the form of the comma-baccilus so well known since. Under favourable conditions this bacillus propagates with uncommon rapidity, and spreads in the same manner as the typhoid germ, especially, as experience shows, by the agency of water used for drinking and domestic purposes.

To prevent the spread of the epidemic, the isolation of the patients, and disinfection must be carried out far more strictly than in the case of typhoid. In particular, besides the excretions of the patient, those of all persons in his vicinity, who are already possibly infected, must be made innocuous, for experience teaches that the infection of cholera can be communicated to others in a severe form by such persons, even though they themselves are not visibly affected. The regulations mentioned in § 153 for the supervision of traffic, have proved beneficial in the case of cholera. Especially the establishment of medically conducted stations on the water-ways for the supervision of the seafaring population has proved successful. This precaution already adopted by some countries, was, at the Congress held at Dresden by many European powers in

1893, with reference to the prevention of cholera, recommended for general adoption. The success of preventive measures will be all the more certain, the greater the care taken in single households, as well as in villages, and towns in regard to cleanliness, proper removal of refuse, and the supply of wholesome pure drinking water. During cholera epidemics we should pursue a regular course of life, avoid medicines, so long as we are healthy, and should not abandon our homes from fear of the disease. Where reliable drinking water cannot be procured, only boiled water should be used for drinking and domestic purposes. We should not use ice, very cold drinks, sour beer, unboiled milk or viands, and stimulants that may cause indigestion. We should procure provisions from reliable, clean shops, and avoid those to be found in cholera-houses. We should not bathe in rivers near cases of cholera, and should use public closets only in cases of necessity. The seats of closets used by strangers, should be daily scoured with soap and water. Those used by persons suspected of disease should be sprayed with chloride of lime. If diarrhœa sets in, we should at once have recourse to a doctor.

§ **205. Dysentery.**—Dysentery belongs to the diseases of an epidemic nature arising from morbid changes in the intestinal canal. It prevails largely in southern countries, and has also caused extensive epidemics in Germany; in many districts it appears regularly at certain seasons of the year. In persons suffering from dysentery, inflammations and ulcers are produced in the great gut, and especially in the rectum. The patients fall into a high fever, and are incessantly tortured by efforts to relieve the bowels; the frequent excretions, always attended with pain, are mixed with mucus, pus, and blood. In a favourable case recovery sets in gradually in two or three weeks often only after a

longer interval; severe attacks may cause death. The infectious matter of dysentery, so far as known, is disseminated by the excretions of the patients; as a safeguard against its spreading, the precautions indicated against typhoid are essentially advisable.

§ **206. Diphtheria, Croup, Tonsilitis.**—An infectious disease justly dreaded in childhood, but also affecting adults, is diphtheria. The number of deaths caused by it among the ten millions of inhabitants of the larger towns in Germany during the decade 1882-1891 amounted to 111,021, and of every thousand deaths 45 are due to this disease. In 1892 the death-rate from diphtheria was 12,631, or 41 per 1,000 deaths.

The disease usually begins with fever, and pains in the throat; on the inflamed and swollen tonsils appear greyish-white dots, and spots, which soon increase to a uniform coating, and generally cover also the uvula and the upper part of the throat. At the same time the lymphatic glands in the neck become swollen, the breath of the patient is foul, and the nose becomes obstructed. Often death ensues in a few days, either from failure of the heart's action, or from swelling of the mucous membrane of the larynx and windpipe, rendering breathing impossible. In other cases, after-diseases, such as inflammation of the lungs, or kidneys, and paralysis, produce a fatal result, or tedious recovery. In consequence of paralysis of the laryngeal muscles, hoarseness, and loss of voice may remain after the disease has passed away.

A formation of a membraneous coating inside the larynx, and branches of the windpipe, sometimes occurs without a previous affection of the throat, such cases result in a peculiar form of disease, distinguished by want of breath, and symptoms of choking, and called "croup." Such a condition of things is called "true" croup, as opposed to

"false croup," a catarrhal disease of the air passages, which is accompanied by swelling of the mucous membrane, want of breath, and danger of suffocation, but not by the formation of a membrane.

Every attack of diphtheria threatens the life of the person affected ; successful results may attend prompt and proper treatment. Thus the doctor has succeeded in averting the imminent danger of suffocation on the appearance of difficulty of breathing by providing a free passage of air to the lungs through an incision made in the windpipe, below the larynx, obstructed by the membraneous coating. Still the patient's life is not always saved by this operation, for by preventing suffocation, only one of the manifold dangers occasioned by diphtheria, is removed. Every year a large number of special remedies against diphtheria, partly with well-meant intentions, partly through love of gain, are recommended, in the form of secret cures, and are frequently adopted by credulous persons. The results guaranteed by the dealers in such cures are generally founded on the mistake of diphtheria for milder diseases of a similar appearance, *e.g.*, the various forms of tonsilitis.

This disease often appears along with high fever, and a very noticeable swelling of the dark-red tonsils, and next a whitish coating, similar to the coating in diphtheria, may show itself. Sometimes there occurs a collection of matter inside the tonsils, which unless an incision is promptly made, gradually bursts into the mouth, causing great pain to the patient. Apart from a few rare exceptional cases, tonsilitis ends favourably in a few days, without leaving behind any after results.

According to present experience it is not quite certain that tonsilitis may not be communicated from one person to another, but a far greater facility of contagion belongs to diphtheria. Its germs adhere especially to the lining of

the throat, pass thence into the saliva of the patient, even into the nasal discharges, and seem to remain for a long time in an active condition with dried expectoration, in dwelling rooms, linen, clothing and utensils.

To prevent the spread of diphtheria, the precautions indicated in regard to scarlatina may be recommended; special care should be taken to render the expectorations of diphtheria patients, and even the pocket-handkerchiefs used by them, harmless by means of disinfecting fluids. Kissing persons ill of diphtheria is to be strictly avoided.

§ **207. Whooping-Cough.**—This is an infectious disease almost exclusively confined to children under ten years of age. The disease begins with the ordinary symptoms of a cold, perhaps after a week, violent, and prolonged fits of coughing set in, during which the child gets black in the face and seems to be choking. Each fit usually ends with a deep whistling inspiration, whence the disease has received its name, whooping-cough. Only a little phlegm is usually expectorated by the coughing, yet the violent irritation often causes vomiting. The attacks, which deprive the child of sleep, particularly at night, become less frequent and violent after some time, and finally cease altogether. In unfavourable cases, especially with weakly children, death sometimes ensues from exhaustion, or as the result of inflammation of the lungs.

The infectious matter of whooping-cough, it is believed, adheres to the phlegm expectorated when coughing, which is frequently very small in quantity. The disease is easily communicated, either directly by the intercourse of healthy children with those affected, or by means of pocket-handkerchiefs, etc. Children suffering from whooping-cough should be always isolated, and especially should not be allowed to attend school. Their linen is most easily disinfected by thorough boiling.

§ **208. Influenza.**—Like whooping-cough, influenza or "grippe" most frequently attacks the respiratory organs as the seat of its manifestation. Influenza has repeatedly spread across Europe, and has then attacked the majority of the inhabitants of the country visited by it. The beginning of the last great epidemic occurred in the year 1889. Many instances of communication of the virus from person to person are offered as an explanation of the spread of the disease; still, weather conditions and other circumstances are powerful factors in promoting the development of the epidemic.

"Grippe" appears as a more or less high fever, great debility of the patients, painful twinges in the limbs, and violent headache. As a rule, coughing with expectoration sets in, and in other cases stomach and intestinal catarrh. Recovery usually begins after a few days: still a continuance of the debility, and even cases of death are frequent. In particular, concomitant and consequential ailments, as inflammation of the lungs, disorders of the heart, ears, and kidneys, give rise to such unfavourable results.

§ **209. Inflammation of the Lungs—Pleurisy—Peritonitis.**—The inflammation of the lungs appearing both as an independent malady, and also in conjunction with other infectious diseases, varies greatly in symptoms, course, and results according to its cause. In the term "inflammation of the lungs" is included various diseased processes, usually accompanied by fever, and which, in consequence of a filling up of the lung-vesicles with secretions, sometimes small and sometimes large portions of the lungs, become incapable of taking part in the respiratory functions. The patients are thus obliged to hasten their breathing (want of breath), and suffer pain in the affected portions of the lungs.

The illness usually understood by the term "inflamma-

tion of the lungs" generally begins with violent shivering, and is marked by high fever, stitches in the side, and want of breath. Along with a racking cough, the patients expectorate, at first only scanty, but afterwards large quantities of viscous phlegm, coloured like iron-rust through an admixture of blood. By proper treatment of the patient, inflammation of the lungs has a favourable issue more frequently than might be expected from the severe symptoms of the disease; about a week after its commencement, the fever, and want of breath generally cease, and convalescence ensues, along with abatement of the pains in the chest, and of the cough. In such cases the secretions in the lung are either gradually coughed up, or absorbed by the lymph-vessels. In severe cases, perilous suppuration, and other disorders of the lung may be developed. Sometimes death ensues after a few days of the illness, especially with aged persons, or those debilitated by excessive use of alcohol.

Inflammation of the lungs was formerly numbered among diseases brought on by chill, but is lately regarded as an infectious disease (whose appearance is apparently favoured by weather changes), and is now connected with micro-organisms. On the assumption that the latter are disseminated by the dried, and dust-blown expectoration of the patient, it is advisible to disinfect all such expectoration, and the handkerchiefs, linen, etc., soiled by it.

Inflammation of the lungs is sometimes followed by pleurisy (a disease endangering the life of the sufferer), that often develops independently: it causes secretion of fluid in the space between the lungs and the pleura lining the inner surface of the thorax, and often in such large quantities, that breathing becomes difficult or impossible through interference with the movements of the lungs. In many cases the fluid exhibits a bloody, or purulent character.

In peritonitis, which sometimes follows injuries to, or other diseases in, the covering of the abdomen and abdominal organs, a watery or purulent fluid is secreted by the peritoneum The patients usually suffer violent pains, and frequently die in great agony.

§ **210**. **Epidemic Stiff-neck — (Black Death) — Inflammation of the Cerebral Membrane.**—By epidemic stiff-neck is denoted a feverish infectious disease, which is caused by inflammation of the membranes surrounding the brain and spinal cord, and in its course is accompanied by vomiting, violent pains in the head, neck, and limbs, stiffness of the neck, and paralysis of individual muscles. The disease sometimes spreads widely, especially in winter and spring, amongst children and young persons, and ends fatally in about one-third of the cases: in cases of recovery, deafness, blindness, maiming, and mental disorder often remain behind.

Inflammation of the cerebral membrane makes its appearance in a similar way, It appears particularly, as a dreaded after-disease of various infectious diseases, as well as in connection with injuries to the head, or diseases in the ears.

§ **211. Intermittent Fever.**—Intermittent fever, or cold fever is a disease which likewise owes its origin to micro-organisms, and is not under ordinary circumstances spread by communication of the virus from person to person. It occurs especially in marshy districts, exposed to flooding, and is indigenous in many parts of Germany, where it does not however, produce generally fatal results. In a hot climate this fever appears to a far greater extent, and under severe forms as virulent malarial, or tropical fever.

The cases of this disease observed here, are characterised by attacks of high fever, lasting for several hours, recurring

every three or four days, and usually introduced by shivering: the health of the person attacked is lowered even during the intervals free from fever. Instead of attacks of fever, violent neuralgic pains (especially in the forhead), also interrupted by intervals, may set in. By proper administration of quinine—a medicine obtained from the bark of the cinchona tree found in South America—recovery frequently follows such maladies in our climate. The disease has almost disappeared from districts formerly ravaged by it, owing to the draining of swamps, regulation of floods, &c.

§ **212. Yellow Fever and the Plague.**—The home of two dreaded epidemics, yellow fever, and the plague, at present lies outside our continent. Yellow fever appears chiefly in the coast lands of Central and Southern America, and in West Africa. The increased speed of sea-traffic appears to justify the fear, that soon the virus of this fever may find entrance, and spread in European sea ports. The disease exhibits itself in violent fever, pains in the head and back, a yellow colour of the skin and eyebrows, vomiting of bloody masses, anxiety of mind, and even delirium; it runs its course in ten or twelve days, unless death supervenes previously. Recovery is very tedious.

The plague (also called oriental pestilence) has shown itself during the current century only in some coast lands of Northern Africa, and Western Asia in 1879, and in Southern Russia, and recently in China, and on each appearance has caused great sacrifice of human life. In past centuries it has visited Europe with severe epidemics, and in particular, the "black death," a disease synonymous with the present day "plague," has wrought incredible devastation. The pestilence is known by high fever, delirium, and swelling of the lymphatic glands in the neck,

armpits and groin. The swollen glands assume the form of red protuberances, burst and become festered; the majority of persons attacked die within the first week. It is believed that yellow fever, and the plague are communicated from person to person, as well as by means of clothes, and other objects.

§ **213. Wound diseases.**—A series of infectious diseases are described as "wound diseases," because their origin is associated with the presence of abrasions in the skin; their excitants are found in dust, dirt, and impure water. We may prevent the entrance of disease germs by avoiding any contact of foreign bodies with the wound, by carefully cleansing its circumference, and by using as bandages, asceptic materials. We should not omit, before putting on a bandage, cleaning the hands thoroughly, and removing the dirt from under the nails. The materials for bandaging should be procured from the most trustworthy sources, and a fresh package should be opened on each occasion, and the bandage laid on the wound without creases.

After use, the bandaging materials should be burnt, and not in any case, used again. The carrying out of these precautions, as well as bandaging itself, can only be learned by practice, and hence the treatment of wounds should be entrusted to trained hands wherever possible. Wound diseases were formerly very frequent. Pain and fever arising from inflammation, was regarded as necessarily arising from the healing of the wound; and it was considered unavoidable, that various and even severe wound diseases, should appear epidemically among the wounded in military hospitals.

Since the introduction of the so-called "antiseptic" treatment of wounds, by the English surgeon, Lister, in which the highest importance is attached to cleanliness in dealing

with wounds, these diseases have been observed only in exceptional cases.

§ **214. Inflammation, Suppuration, Whitlow, Boils, Carbuncles.**—The most simple wound disease, is a simple inflammation of the tender parts in the immediate neighbourhood of the wound, characterised by painfulness, swelling, heat, as well as fever ; with these indications, suppuration is frequently associated. The matter collects particularly in the tissues of the under skin, partly destroys this, and can acquire considerable dimensions (especially in the case of superficial abrasions that have remained unnoticed) before it breaks through the opposing cuticle, and is discharged externally. A prompt incision in such cases may shorten the duration, and extent of a suppuration.

By whitlow is understood an inflammation, generally proceeding from small unnoticed abrasions on the inside of the finger, and easily leading to suppuration, and, if neglected, to more serious consequences, such as destruction of the sinews, resulting in stiffening of the finger, or of the wrist, and weakness or incapacity of the arm ; nay, even by spreading to other parts of the body, it may imperil life. We should not delay on such occurrences to promptly seek medical advice.

A confined collection of matter is called an " abscess." A circumscribed inflammation of the skin (whose origin is often untraceable, and is to be sought in a small skin gland, that has become accessible to one of the excitants of inflammation) is known as a boil. If several boils lie close beside each other, they unite in a "carbuncle" which sometimes endangers life.

§ **215. Inflammation of the Lymph Vessels and Glands.—Purulent and Putrid Fevers.—Puerperal Fever.**—If the disease germs

present in the wound, or inflamed portions of the skin, pass into the lymph vessels, inflammation of these vessels, or glands arises. The vessels become noticeable as painful cords, appearing red through the skin, and running to the lymph glands lying nearest the wound. The latter well, become painful, and may finally suppurate. If certain inflammatory agents pass through the sides of the small veins into the blood, and by the latter into the other organs, the severe maladies of the whole body known as putrid and purulent fevers (blood-poisoning), are produced. Puerperal fever, a disease of women in childbed, arising from the penetration of inflammatory agents into the parts injured in delivery, usually follows the same course as one of these two diseases. Like every wound disease, it can only be avoided by great care and rigid observance of all regulations as to cleanliness on the part of those assisting at the birth.

§ **216. Erysipelas and Gangrene.**—Erysipelas appears in the neighbourhood of wounds as a painful inflammation of the skin, distinguished by swelling, and a peculiar rosy red colour. It soon spreads further, and sometimes as migratory erysipelas, covers a large part of the surface of the body. It is preceded by shivering, runs its course accompanied by high fever, and hence gives the impression of a severe illness. Erysipelas in the face and head, formally claimed as a malady arising from chill, is a wound disease whose starting point is minute abrasions, *e.g.*, small spots of the mucous membrane that have become injured by catarrh. In relatively few cases does erysipelas lead to death; most illnesses caused by it, terminate favourably, as the fever ceases in about a week, and the cuticle scales off at the parts affected. If hairy portions of the skin are attacked the hair usually falls out, but soon grows again.

A local death of portions of the body, sometimes resulting upon wounds, is known as "gangrene." It, at times, develops into complete destruction of the parts near the wound, and often causes the total loss of limbs, and even the death of the person attacked. Its name is derived from the peculiar dark, almost black colour, of the parts of the body affected. Similar symptoms occur on other occasions—*e.g.*, frostbite, or even independently in consequence of obstructed circulation.

§ **217. Tetanus.**—Tetanus is one of the most dreaded wound diseases, on account of its usual fatal result, and of the tortures endured by the patient. Opening of the mouth, chewing, swallowing, breathing, become difficult, owing to painful spasms of the jaw, neck, and larynx. The spasms subsequently disappears, it is true, yet slight contact, motions, even auditory and visual sensations, may recall them with lightning speed. Single fits, coursing spasmodically through the entire body, and incessantly repeated, exhausts the strength to such a degree, that few patients survive their sufferings.

§ **218. Contagious Diseases of the Eye.**—Inflammation of the tunics of the eye are caused by the entrance of dust and dirt, in the same way as wound diseases. The mucous membrane becomes red, effusion of tears increase with the secretion of matter, pains in the eye, and avoidance of light ensue. Occasionally there are formed on the edges of the eyelids swellings resembling boils, called "styes."

If the inflammation passes from the conjunction to the cornea, ulcers are produced on the latter, which leave behind opaque scars, interfering with the power of vision. A simultaneous affection of the inner parts of the eye may occasion diminution of visual power, blindness, and loss of the organ.

One of the most dangerous forms of inflammation of the conjunction—*i.e.*, the infectious eye diseases of new-born children—has been already mentioned (§ 158). Another infectious form, the contagious or epidemic eye disease, also called "trachoma," is especially indigenous to Egypt; it was thence imported into Europe by the soldiers of Napoleon, and since then occurs in some districts of Germany, under the name of Egyptian, or granular disease of the eye. The communication of this very dangerous disease to the eyes is effected by means of the hands, towels, etc. We should therefore, be on our guard against contact with patients suffering from this disease, and should never use their linen without previous disinfection. The spread of the disease is most reliably prevented by submitting immediately to proper treatment as soon as attacked.

§ **219. Contagious Animal Diseases.**—Certain infectious diseases of animals are sometimes communicated to men as wound diseases, through their germs finding admission into the human body by means of existing abrasions, or through bites. Such diseases of animals are Hydrophobia, Anthrax, and Glanders.

§ **220. Hydrophobia.**—Rabies or hydrophobia is a disease most frequently observed in dogs: its virus is contained in the saliva of the animals affected, and is transferred to human beings by the animal licking sore parts of the skin, or by bites. Such transfers result, in half the cases, in a severe illness of the individual in question, the disease breaking out in twenty or forty days, or even a longer time, after infection. The patients first experience weariness, headaches, pain, and difficulty in swallowing, or speaking. After a few hours or days, cramp ensues in the muscles used in swallowing, and breathing, especially in making an effort to drink, and subsequently even at the

thought of drinking or swallowing. These attacks may also arise on other trifling irritations, such as draughts, looking at shining objects, sudden contact with any object, etc. Their frequent repetition causes a rapidly-increasing weakness, and leads in a few days to the death of the patient. To prevent the development of the disease, it is necessary to suck, cut off, cauterise, or burn wounds caused by the bite of suspicious animals. In France and other countries, where rabies occur far more frequently than in Germany, institutes for inoculation against rabies, have been established at the instigation of the famous scientist, Pasteur.

§ **221. Anthrax—Glanders.**—Anthrax appears particularly in sheep and cattle, and more rarely in pigs and horses. It is produced by a rod-like bacillus which is contained in large numbers in the blood and in many organs of the diseased animals, and can also be artificially reared outside the body without losing its activity. As the "anthrax bacillus" forms spores, the infectious matter of the disease may retain its vitality for a long time—*e.g.*, in coagulated blood. Its transfer to men may be effected by means of the flesh, horns, or skin ; the slaughtering and skinning of animals, and the manufacture of their hides and hair, furnish the occasion for this. It seems that the virus may be introduced into the human body even by the sting of insects that have eaten of the diseased flesh.

In man the disease shows itself generally by the so-called "anthrax carbuncle," a circumscribed and very violent inflammation of the skin, accompanied by pustules, and burning sensations, or it appears as the more extensive anthrax swelling, but marked in its course by the same symptoms. By the passage of diseased substances from the original seat into the track of the blood, a dangerous general sickness may be produced, along with high fever

Diseases arising from the eating of the flesh of animals afflicted with anthrax, and characterised at first by violent vomiting and diarrhœa, run a similar course.

Glanders appear in horses and other one-hoofed animals, and may be communicated to man by the mucus from the animal's nose, the secretions of skin ulcers, by the blood and also by the sweat, saliva, urine, or milk of such animals; it is most frequently transferred by the virus penetrating skin-wounds. Ulcers, and inflammation of the lymph-vessels and neighbouring lymph-glands are produced at the point of entry of the disease-germs. This is followed by fever, pains in the limbs, pustular skin eruptions, and the production of deeply-seated tubercles which break, and form ulcers. Even in the nose, and the inner parts of the body, tubercles may develop, and other inflammatory changes. The disease, almost without exception, results in death in a short time, or after a period, extending over months or even years. By burning or cauterising the wounds or ulcers suspected of being infected, the disease may sometimes be prevented.

§222. Other diseases of Animals that may be communicated to Man.—Among other animal diseases, various skin-diseases (scab in horses and dogs, ringworm) caused by animal, or vegetable parasites, may spread to man; this is also the case with the foot-and-mouth disease noticed particularly among cattle, sheep, and pigs. The virus of the latter is found in small pustules in the mouth, in the neighbourhood of the feet, and at the udder of the diseased animals, and may be communicated through the use of unboiled milk, or by soiling the face or hands in tending the animals. The diseases caused by trichina, and other parasites, transferred to man through eating animal flesh, have been already mentioned (§ 83).

Leprosy causes prolonged and severe chronic debility.

This disease (regarding those origin and mode of dissemination, only imperfect knowledge is as yet attained) is now chiefly found in Eastern countries, but also still makes its appearance in several European, especially in Norway, some provinces of Russia, in Turkey and Spain. In Germany, where at present there are only a few lepers, there were such considerable numbers in former centuries that every large town had its special lazar-house for such patients. The disease is characterised by the development of tubercles and eruptions on the skin, and by nervous disorders, but in its course it also attacks other organs, and leads to death after lasting several years. In districts visited by leprosy, efforts are made to protect the healthy by isolating those suffering from the disease from all intercourse with others.

§ **224 Tuberculosis.**—A series of externally very dissimilar diseases, almost all of which are chronic, are included under the name of Tuberculosis. The proof that these apparently dissimilar maladies had a common cause, and hence were essentially alike in nature, was brought forward some years ago by Herr Koch's discovery of the tubercle-bacillus. This minute organism, found in all diseases akin to tuberculosis, may remain for a long time capable of development outside the body, and hence efficacious as an infective agent. Inside the body it gives rise to the formation of small tubercles, and the production of inflammatory processes. Decay, disorganisation, and ulceration ensue through the tubercles, the inflamed tissue gradually changing into a white dry crumbling mass, resembling cheese, and with concomitant suppuration. The ulcers form means of ingress for other disease-germs, by whose agency the characteristic symptoms of the disease may be changed in manifold ways.

A frequent co-symptom of tuberculosis is the so-called

hectic fever, which causes considerable rises in the temperature of the body at definite periods of the day, especially at evening, and along with nightly perspiration, weakens the patient. Sometimes this fever betrays itself in the patient at an early stage by well-defined red spots on the cheeks, which become especially visible during slight exertion, sense impressions, and emotions.

§ 225. Individual Forms of Tuberculosis.—The most frequent form of tuberculosis is pulmonary consumption. Between the years 1888 and 1892, this disease carried off 34,433 persons among the eleven millions of the urban population in Germany, *i.e.*, about three in every 1,000 inhabitants, and it caused nearly 13 per cent. of the deaths. Besides the symptoms peculiar to tuberculosis in general, it is marked by coughing, expectoration, and shortness of breath. Frequently bleeding occurs as a result of the destruction of the sides of the lung-vesicles, and is evidenced in a bloody colour of the expectoration (blood-spitting); sometimes it increases to a dangerous extent, and may lead to the throwing up of large quantities of blood (violent hæmorrhage of the lungs).

Tuberculosis frequently appears in the bones, resulting in "Caries," or extensive destruction. If the dorsal vertebræ are the starting point of such a disease, there is formed a projecting knob on the back, corresponding to the seat of the disease, by the sinking in of the decaying vertebral body. At the same time may arise injury or concomitant disease of the spinal cord, and in consequence, thereof, paralysis of the lower limbs, or difficulty in the working of the urinary organs and bowels. Tubercular disease of the ends of the bones may easily extend into the neighbouring joints. The former, at first, causes pains

and limping, and in its further stages it may lead to suppuration, destruction of the joint, loss of the limb, and even death.

The tuberculosis of the cerebral membranes, occurring especially in the case of young children, is marked at first by depression and digestive troubles : soon however, delirium sets in, convulsions and paralysis appear, and almost without exception, the sufferer dies in a few weeks. General tuberculosis runs its course still more quickly ; it arises from the bacilli from a local seat of the disease, spreading suddenly throughout the entire body. Death ensues in a short time, accompanied by a fever resembling typhoid. Moreover, tuberculosis in the intestines, mesentery, and abdomen, quickly puts an end to life.

Among tuberculous skin diseases, mention must be made of lupus, a malady appearing particularly in the face, which causes extensive ulceration and disfigurement, and even the entire loss of the nose.

§ 226. Scrofulous Maladies—Curable nature of Tuberculosis.—Under the term scrofulous maladies are included some lighter skin-diseases arising from tuberculous causes, and also the tuberculous diseases of the glands characterised by swelling, whitening, suppuration and ulceration; it also includes inflammations of the cornea, marked by obstinacy and a tendency to relapses, and many disorders of the ears, accompanied by suppuration. Formerly it was thought that these maladies, and also the above-mentioned affections of the bones, should be regarded as class of diseases distinct from tuberculosis, because they appear more especially in children, and have a favourable termination more frequently than the tuberculous maladies already described ; when the existence of the tubercle bacillus in the diseased parts was proved, their tuberculous nature was admitted, and the former belief in

the incurable character of tuberculosis was abandoned. In fact, even consumption often ends in recovery; the cases that have terminated favourably have frequently been recognised when the patients have afterwards died of other diseases, and the *post-mortem* examination has revealed the traces of past lung disease. Cases also, in which pronounced symptoms of tuberculosis are present, can, by prompt and proper treatment, be cured, or at least, receive such a favourable turn, that life and working-power are preserved for many years to the patient. Hence, there should be no delay in seeking medical advice if persistent coughs, expectoration, mixed with traces of blood, decline in bodily weight, digestive troubles, pains in the joints, &c., arouse suspicions of the presence of tuberculosis.

§ **227. Dissemination of Tuberculosis and Preventive Measures against it.**—Since the discovery of the tubercle bacillus far more reliable information has been obtained as to the manner in which the disease is propagated. It is, of course well known that the pre-disposition to the disease is transmitted from parents to children, and that a chance cold may prepare the ground for phthisis; but nowadays the cause of the propagation of the infection is primarily looked for in the transfer of living disease-germs. It is proved that these germs leave the patients' bodies with their excretions, *e.g.*, expectoration, matter, or excreta from the bowels, and retain their power of infection, and hence danger, for a long time exists after they dry up. These germs have been found in the dust of bedrooms, and other apartments occupied by tuberculous patients, and thus have been traced many cases of tuberculosis, arising from living with such patients, or among the dwellers in apartments which have been occupied by them. Since it has become known, that a frequent disease among cattle, viz.—murrain—is merely

tuberculosis, the conviction has gained ground that the milk of diseased cows has spread the disease, among children especially.

The above-mentioned observations, and experiences require, that the excretions of persons suffering from tuberculosis ought to be made innocuous, that the dangers arising from the intercourse of such patients with healthy persons should be averted as far as possible, and that the use of milk containing bacilli of tuberculosis should be prevented. For these purposes the following regulations may be recommended :—

Fig. 42.

1. All persons, but especially those proved to be affected by the disease, should accustom themselves to deposit their expectoration in spittoons. The spittoons should contain, either fluids which will prevent the expectoration from drying up and turning into dust, or easily combustible substances such as sawdust. They should be emptied when full, or at least once a day, and the contents be made innocuous by disinfection, or burning. Where the use of spittoons is impossible, as in walking through the streets, such patients should carry with them little vessels (Fig. 42) for the reception of their expectoration ; but they should never spit on the ground, or in their pocket handkerchiefs.

2. Linen and utensils of the patients are to be thoroughly boiled each time after use ; their dwellings should be disinfected before they are occupied by other persons.

3. No dust should be left in apartments occupied by consumptives. Large curtains, thick carpets, and other

pieces of furniture known to absorb dust, should be replaced by flat objects easily washed.

4. The sleeping together of consumptives and healthy persons in the same rooms or beds, and the employment of consumptives in the cooking, or selling of food, cigars, &c., should be prevented as far as possible. Where consumptives must work along with healthy people, the superintendent of the works should make the observance of the first regulation a condition on all workers.

5. The sale of the milk of cows suffering from tuberculosis should be forbidden. The use of unboiled milk is generally to be disapproved, when it cannot be procured from a reliable source.

III.—Other Diseases.

§ **228. Diseases of the Nerves and Brain—Obstruction in the Formation of the Blood and the Metabolism of the Body**.—The group of nervous disorders embraces numerous diseases, in part only closely investigated in recent years. Their external symptoms, *e.g.*, paralysis, weakness, cramps, pains, loss of feeling, of the faculty of thought, of consciousness, illusions, have been frequently traced to definite changes in the brain, the spinal column, or the nerves. Wettings, chills, or past infectious diseases have been made responsible, with more or less justification, for many nervous disorders. In numerous cases mental over-exertion, over-excitement of the senses and feelings, dissolute manners of living, have preceded the disease. Frequently, and especially if an alteration in the nervous organs cannot be proved, despondency, and want of will-power in the patient must bear the guilt of the development of the disease, or of its unfavourable course.

Many of the nervous disorders may be cured by proper treatment of the patient, conducted by experienced physicians; in others such treatment may succeed in giving the disorder a favourable turn, or in prolonging the patients' life. Hence, it is advisable to seek medical advice on their appearance. This holds especially, for cases where striking loss of memory, irritability, senseless actions, and other symptoms lead us to suspect the beginning of some mental disease. Often the imminent disease may be averted or moderated; in any case, prompt knowledge of it may restrain the patient from actions that may have ruinous results for himself, or those around him.

Among the interferences with blood formation and metabolism or tissue changes, is included "chlorosis" or "green-sickness"—a disease very frequent at present among growing females. Its development may be counteracted by wholesome care of the body, nourishment, and clothing. In particular, girls during childhood and their years of growth should diligently exercise themselves in the open air, avoid much sitting, excessive mental work, dancing, parties, and similar pleasures, which cause unusual excitement, extend far into the night, and shorten sleep.

Among diseases frequently resulting in death, whose nature is based on changes in the quality of the blood, may be mentioned, "leucocythemia" (increase of the white blood-corpuscles) and various kinds of anæmia (destruction of the red-blood corpuscles). One form of the latter disease is produced by a small intestinal worm, the "anchylostomum duodenale," which multiplies rapidly in the duodenum of the patients. This disease has been observed of late years in many districts of Germany, especially among bricklayers and earth-workers.

Much better known is diabetes, an interruption in the metabolism of the body, whose origin is as yet but little

known; in it, the urine of the patients, evacuated in considerably increased quantities, contains grape sugar. The disease is first marked by an unusually great feeling of hunger and thirst, as well as by a condition of relaxation and weakness. It may lead to death in a few months through improper treatment; but if the patients regulate their mode of life strictly according to medical advice, working-power and life may frequently be preserved for a long time. Gout is produced by the deposition in various parts of the body of the salts which should have been excreted by the urine. It appears in the form of intermittent attacks, leads to painful swellings of the joints, and among the latter, prefers that between the middle of the foot and the great toe. It also produces gouty deposits in the skin, and diseases of the internal organs. According to popular belief, the disease visits pre-eminently those persons who indulge in high living; still gout is not rare among the less wealthy classes largely exposed to want. The number of attacks may be reduced, and life prolonged by a simple, healthy mode of living.

§ **229. Tumours and Cancer.**—Many so-called tumours produce tedious illness, and frequently fatal results. By tumours are meant morbid structures, which may develop on the surface, or in the interior of the body, and possess a tissue, differing in quality to the organ, or part of the body affected.

They are divided according to their nature into benign and malignant. The first class includes among others, the encysted and fatty; it is distinguished from the second class (the chief members of which are cancerous tumours) by the growth being confined to the part first affected, and the absence of general infection. A benign tumour may cause disfigurement by its size, and inconvenience by its position, and may even endanger life by its growth in one of the vital organs, but, it produces neither secondary

tumours in other parts of the body, nor as a rule, symptoms of general illness or nutritive troubles. Its removal by an operation destroys immediately and permanently the inconveniences arising from it. On the other hand, a malignant tumour, besides a more rapid growth, often shows a disposition to propagate itself. In the neighbourhood of a cancerous growth there sometimes develops similar morbid swellings of the lymphatic glands, and sometimes later, cancerous knots appear in various parts of the body remote from the original seat of the disease. At the same time such tumours become open, decay into ulcers on their surface, and discharge matter generally possessing a foul odour. The patients suffer much pain, and other inconveniences due to the situation of the growth ; they fall into bad health, and die unless medical aid succeeds in removing it. Unfortunately such aid often comes too late, since the danger from the growth, at first appearing only as an insignificant knot, is underestimated, and the surgeon's knife is avoided until the development of more considerable troubles. As soon as the disease has extended to the lymph-glands near its original position, it is generally no longer possible to avert an unfavourable issue. If an operation is performed in such cases, it only succeeds in alleviating the condition of the patient by removing the suppurating ulcers and the troublesome parts of the tumour, and in thus prolonging his life by a short respite. The prompt treatment by an operation in the beginning of the disease, is the only means hitherto known, by which cancer may be cured ; recommendations of other remedies, proceeding sometimes from good intentions, sometimes from avarice, calculating on the credulity of the patients, only lead to this—that the period for operative treatment is wasted in the application of these belauded cures

A special form of tumour (Echinococcus) is caused by the tapeworm of dogs. This parasite of the dog's intestines, similar in character to the human tapeworm, but only the thickness of a thread, and little more than 1 c.m. long, produces eggs, pass from the dogs with their excreta, and are sometimes transferred to human beings by licking. In man these eggs grow in the intestinal canal to the embryonic form of the worm, and in this state pass by means of the circulation to different parts of the body. Here the intruder forms cysts similar to those in cattle and swine (*cf.* § 83). These increase in time to extensive tumours, which may enclose derivative cysts, and frequently endanger life through being situated in a vital organ, inaccessible to the operating knife, *e.g.*, the liver, or brain. The numerous instances in which prolonged severe illness and death have resulted from this disease urgently point to prudence in our relations with dogs. In particular, children should be prevented from allowing themselves to be licked by such animals.

IV.—Accidents.

§ **230. Frequency of Accidents—Value of the First Assistance Offered—Various Kinds of Accidents.**—Accidents occupy a prominent place among the external influences injurious to health. In the decade 1883 to 1892, among every 100,000 inhabitants of the larger towns in Germany, 32 to 34 died every year in consequence of fatal accidents. The number of temporary, or permanent injuries to health resulting from accidents, is to be put at a far higher rate, *e.g.*, besides 6,000 accidents with fatal results in the year 1892, there occurred

49,000 other accidents for which the insurance societies had to pay compensation to the injured.

The mode of preventing accidents was treated in another section (§ 179). The removal or lightening of their results does not a little depend on the quickness with which professional aid is procured for the injured. Any loss of time may be prejudicial to the person injured; hence the doctor is not to be waited for in every case, but measures should be taken as soon as possible, for the relief of the sufferer. But this can only be done, if the persons present to render the first assistance, are acquainted with measures necessary for proper treatment, and apply their knowledge with care. Therefore we should try to make the information as to first aid to be given in accidents, accessible to the widest possible masses of the people, and to spread the knowledge necessary for this purpose, both by printed instructions, as well as by oral teaching in the so-called "Samaritan Schools," in the army, among official and trade societies.

Among the injuries to health caused by accident are wounds from external violence, burns and corrodings, poisonings, light and severe cases of swooning, the various kinds of apparent death or trance, and the intrusion of foreign objects into the natural apertures of the human bodies.

In attempts at rescue or resuscitation, unnecessary spectators should be removed.

§ **231. Wounds and Bleeding.** — Injuries causing abrasion of the skin are called wounds. Their importance depends on their extent and depth, the locality of the injury, and the rapidity of the process of healing. Cicatrization ensues most speedily if (as in many wounds from cuts) the edges of the wound can be brought together;

the healing process proceeds more slowly in extensive wounds, whose surface must first be filled up by red flesh-corpuscles (in large growth also called "proud flesh"), and in contusions, whose more or less injured edges break off gradually from the tissue that has remained sound. By wound-diseases (*cf.* §§ 213-217) the process of healing may be considerably delayed even in the case of slight wounds.

Wounds should neither be touched with the finger or washed with a sponge, nor should popular remedies for stopping bleeding, such as German tinder, cobweb, &c., be applied, as they only pollute the wound. Moreover, the household supplies of linen and lint, even if they appear to be clean, are not as a rule, so clean that the presence of dangerous germs in them is excluded, hence they are not suitable for stopping bleeding, or bandaging wounds. Coagulated blood (clots) should not be removed. If the wound, however, is soiled by sand or otherwise, in case medical aid cannot be procured quickly enough, it should be syringed carefully with water that has been boiled, and allowed to cool, or with the weak carbolic solution to be obtained from the chemist. For this purpose only a syringe and irrigator (§ 246), previously cleaned with boiling water must be used, and the stream of water, &c., must not be allowed to strike the wound directly.

Small superficial wounds generally heal quickly under a covering of ordinary yellow sticking plaster; larger wounds should be protected against dirt by a clean bandage fastened by a string, or cloth, until a skilled person arrives. Sometimes however, bleeding makes a further and quicker treatment desirable.

The character and danger of bleeding depends on the kind and number of the blood-vessels injured. If the blood trickles from the wound uniformly, and not in a forcible stream, only the capillary vessels and small veins are

injured; a slight pressure by means of a clean bandage (fastened by strings) on the wound, is sufficient to stop the bleeding. A similar, only more firmly attached bandage stays the bleeding from an injured vein, whose character is, the welling-forth of dark blood in a strong stream. (§ 16.) If the blood spouts in a bright red stream from the wound, or if the bleeding proceeds jerkily, corresponding to the heart's beats, then an artery has been injured, and a simple bandage is generally insufficient to prevent the blood streaming from the open vessel, owing to the pressure of the heart's action. Until the arrival of a doctor, who can discover the injured artery in the wound, and tie it, the flow of blood may be prevented by pressing the trunk of the next larger artery, in its course between the heart and the wound,

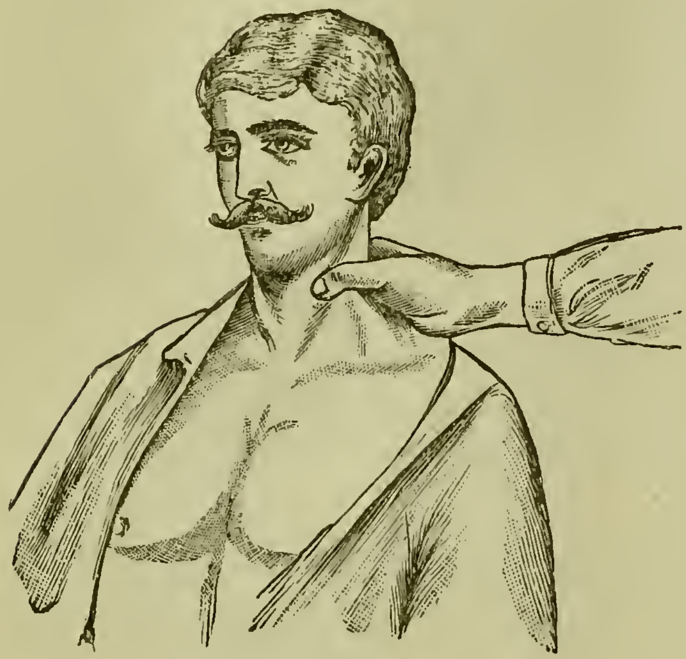


Fig. 43.
Compression of the Carotid Artery.

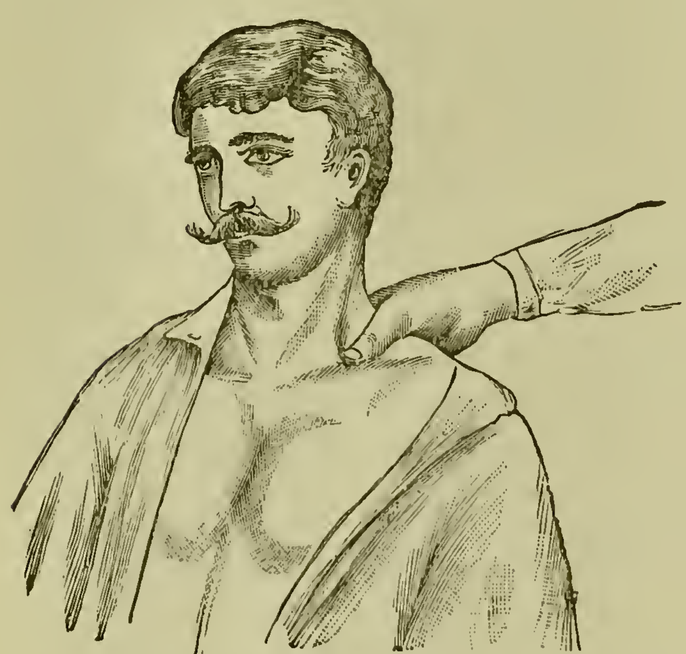


Fig. 44.
Compression of the Subclavian Artery.

against the nearest bone, and thus closing it. Therefore, we should press—

1. In bleeding from the forehead, the temporal artery, just in front of the ear, against the temporal bone.
2. In deep bleeding from the neck, the carotid artery in the hollow, near the larynx, against the spinal column (Fig. 43.)
3. In bleeding from the upper arm and shoulder, the collar-bone artery, against the first rib, the arms, being at the same time drawn down firmly (Fig. 44).
4. In bleeding from the arm, the artery of the upper arm, near the thick flexor muscle, against the bone of the upper arm (Fig. 45).
5. In bleeding from the upper thigh, the artery of the upper thigh in the middle of the groin against the pelvis (Fig. 46).

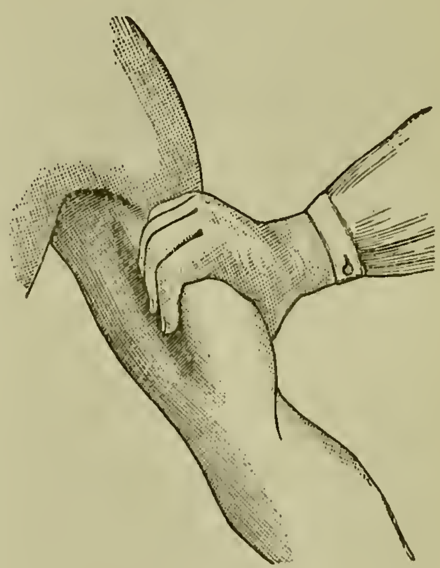


Fig. 45.
Compression of the Brachial Artery.

Arterial bleeding in the forearm and hand may be stopped by closing the artery of the arm by bending the elbow very forcibly. Where the pressure on an artery is required for a long time, the easily tired finger is replaced by a hard body, *e.g.*, by a flat stone (which is first wrapped in a cloth to prevent contusion of the skin), or by a rolled-up bandage. To fasten this body an elastic band (braces), or a cloth is used ; this is tied at the side of the limb opposite to the artery, and is drawn tight by repeatedly twisting a short stick inserted in the knot. (Fig. 47). A contrivance of this kind is called a tourniquet.

When bleeding from the nose sets in, the head should be placed in a raised position, and the garments loosened at the neck. If the bleeding does not stop quickly of its own accord, it may be assisted by drawing ice-cold water, or very diluted vinegar into the nose, or by stopping the nostrils with clean wadding. It may also be beneficial to hold the arms aloft and to moisten the temples repeatedly with cold water. If the bleeding cannot be stopped by these means,

Fig. 46.
Compression of the Femoral Artery.

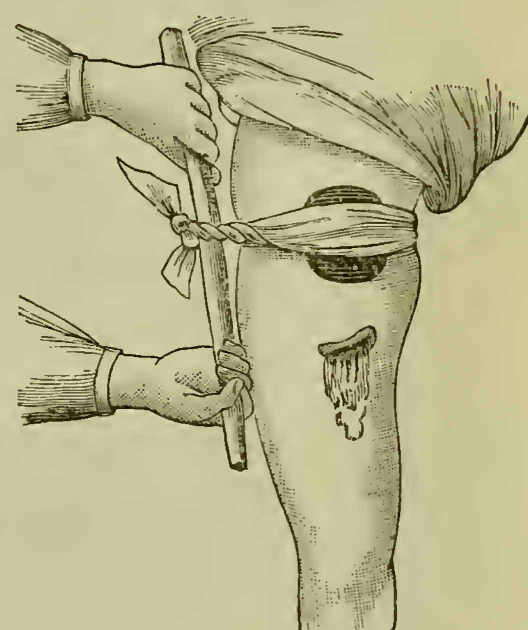


Fig. 47.
Tourniquet.

medical aid should be summoned. In the case of snakebites an effort should be made to extract the poison by sucking the wound ; next, it is advisable to bandage the limb tightly between the bite and the heart, and to cover the wound with cloths moistened with spirits of wine, or of sal-ammoniac, and to send for a physician as quickly as possible.

§ **232. Bone Fractures, Dislocations and Sprains.**—Bone fractures are called simple if the skin

over the fracture does not exhibit an open wound; when it does, it is called a compound fracture. As soon as a bone is broken the part of the body affected loses its support. We cannot stand on a broken leg, we cannot unaided, raise a broken arm, other injuries may render the movement of the limb difficult on account of pain, but cannot make it altogether impossible. As the ends of the bone are shifted nearer each other, a broken limb often appears shortened and thickened in the neighbourhood of the injury (*cf.* Fig. 48). The skin above the fracture usually swells up, and assumes a blue colour from extra-

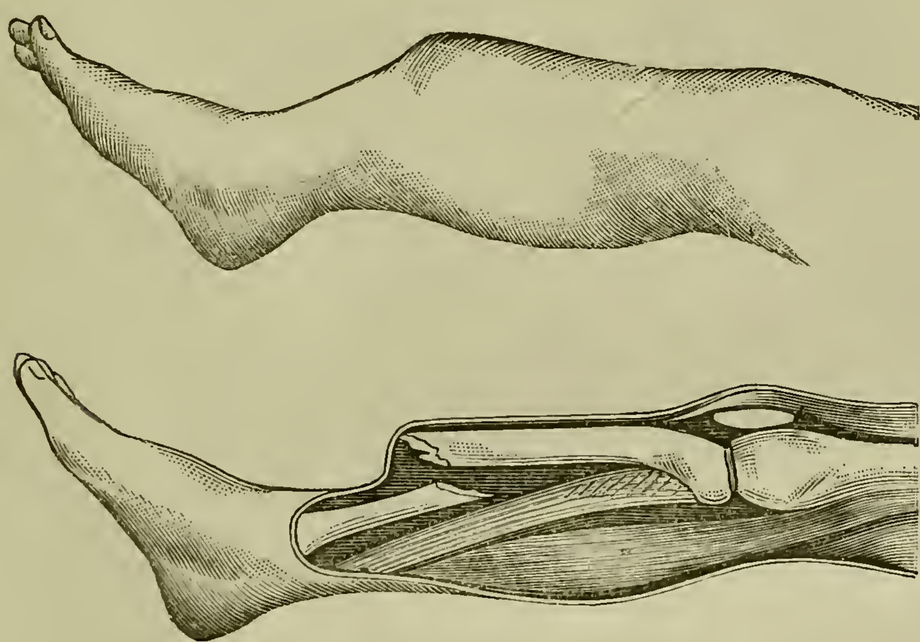


Fig. 48.
Broken Leg. (Exterior and Interior.)

vasated blood. In the effort to raise a broken limb we feel, and often hear, a crunching of the broken pieces, moving against each other, and at the same time we notice, an unusual mobility existing in the limb at the point of fracture. However, the last mentioned indication of a bone-fracture should be ascertained only by the doctor entrusted with the treatment of such injuries, because every movement of a broken limb is painful, and may injure it.

Before the arrival of medical aid most benefit is conferred on the sufferer by ensuring rest for the injured member, *e.g.*, by placing a broken leg on a cushion, and supporting it in position by sandbags, pillows, &c., by fastening a broken upperarm with strings or large cloths to the trunk, and by laying a broken forearm in a triangular cloth, slung by two corners around the neck, and knotted on the shoulder of the uninjured arm (Fig. 49). To reduce the swelling and pain it is useful to apply cold water bandages to the fracture. If it is necessary to carry the injured person away (*e.g.*, into his hcuse or the hospital), the broken part should be supported by splints, cut straight, from wood or strong pasteboard, rolled round with some soft material, and fastened with cloths. This protecting apparatus is properly composed of two splints, a longer one fastened on the outside, and a shorter on the inside of the limb. If possible, both splints, and at any rate the outer one, should be so long as to project beyond the two joints nearest to the fracture, and to admit of being fastened beyond them. In the case of a fractured leg, the sufferer is then placed on a stretcher or in a wagon, being protected as far as possible from all jolting. In raising the injured, several persons should lend assistance ; one should support exclusively the broken limb, by placing one hand above and the other below the fracture. Any movement of

Fig. 49.
Arm Sling.

the ends of the broken bones, or any pressure on the seat of the injury should be carefully avoided.

Dislocations and sprains are treated in the same way as bone fractures. All injuries are called dislocations which cause the starting of a bone from its articulation, mostly by a laceration of the cap of the joint. The power of using the joint affected is withdrawn from the sufferer, or is largely restricted. The neighbourhood of the joint usually become more or less swollen ; the end of the dislocated bone may be felt in an unusual position, and is also visible by the swelling produced ; the place formerly occupied by it appears as a hollow. The setting, *i.e.*, the putting back of the bone into the joint, requires skilled knowledge and practice. Any attempt at setting, by an unskilful hand, causes the sufferer unnecessary pain, and may even produce injury.

By sprains are meant injuries arising from a contusion of a joint, or from a tearing of its ligaments, *e.g.*, by falling on the foot. The joint affected is painful when pressed, or when efforts to move it are made ; the parts around swell, and healing frequently takes a long time. In sprains, as also in contusions of other kinds, cold bandages on the injured parts often do good service. The same remedy, together with a position of entire rest in bed, is to be recommended, until the arrival of a doctor, in the case of a previously unnoticed rupture that has suddenly appeared.

§ **233. Burns and Corrosions.**—Burns are produced by the action of flames, boiling water, hot objects, &c. They are extremely painful and exhibit (according to the violence and duration of the heat), redness of the skin, formation of blisters, or complete destruction of the tissues. Burnt parts of the body should be covered with bandages soaked in oil. Burn blisters should not be cut, and in no case should the upper skin be prematurely removed.

He who wishes to give assistance in fires, should wear wet clothes, and cover his face with wet cloths, so that only his eyes remain uncovered. To quench burning or smouldering garments, the sufferer must be thrown on the ground and covered with sacks, or (in case of burning spirits or petroleum) with sand, and only afterwards should water be thrown on him.

Akin to burns are corrosions produced by quicklime, acids, alkalies, &c. The first help to be given in such injuries consists, in removing the corrosive substance from the surface of the body by drying it up with wadding or cloths. Next the injured parts may be washed with water, and treated in the same way as a burn. Water only increases the corrosive action where quicklime, or sulphuric acid are the agents. Washing with diluted vinegar renders quicklime innocuous; and sprinkling with chalk, ashes, soap and magnesia, or pouring milk over it neutralises the action of sulphuric acid.

§234 Poisoning and Delirium Tremens.—The symptoms of poisoning, by what are called acute poisons, are partly based on their corrosive action. By this class of poisons are meant especially sulphuric acid (vitriol), nitric acid (aqua fortis), hydrochloric acid, aqua regia (a mixture of nitric and hydrochloric acids), oxalic acid, alkalies, and other substances which when swallowed, cause burning of the mucous membrane of the mouth, alimentary canal and stomach, with which they come in contact; also arsenic and phosphorus are acute poisons. The nature of the poison taken is often known by the corrosive traces on the lips, or in the mouth. Before the arrival of the physician in such cases, we may administer milk, barley or water gruel, and mild oil, in order to lessen the agony. In the case of arsenical poisoning a definite antidote may be procured at the druggists. Acids and alkalies may be

used as remedies against each other, inasmuch as in poisoning from acids, innocuous alkaline fluids (such as bicarbonate of soda (bread soda), or chalk mixed with water) are given to the patient; while, on the other hand, diluted vinegar, or lemon-juice are administered when corrosive alkalies have been swallowed.

If phosphorus has been taken, fatty liquids should not be given to the sufferer, because they dissolve the poison, and thus facilitate its transfer to the blood. In such cases water-gruel, or barley-gruel, skimmed milk, and ten drops of oil of turpentine, repeated every half-hour, should be administered.

Poisoning by the so-called "narcotic poisons" is characterised by loss of consciousness, and by the contraction of the pupils (opium), or dilation of the pupils (deadly night-shade, or wild cherries), by convulsive contraction of the muscles (strychnine), and by a congested countenance. If, in such cases of poisoning, vomiting has not already set in, it should be excited, in order to eject the poison, by thrusting the finger into the mouth, tickling the throat with the end of a feather, or by administering an emetic to be obtained at the chemists. In opium and morphia poisoning the victim should be prevented from falling asleep. Narcotised persons should be brought into a warm room, and heated by being rolled in woollen coverings; if the face is pale, the head should be placed in a low position; if it is congested, cold bandages, immersions of the neck, washing the face and breast, or strong emetics are recommended to be used. If the patient is suffering from difficulty of breathing, artificial respiration should be used (*cf.* 237). However, there should be no delay in summoning a doctor, who by antidotes, application of the stomach pump and other remedies, may often avert fatal consequences. If the poisoned person retains conscious-

ness hot, strong coffee, or tea should be given to him. One remedy which acts beneficially, not only in cases of narcotic poisoning, but also in many instances of acute poisoning, is finely powdered charcoal. A special kind of poisoning which in extreme cases may also endanger life, is "delirium tremens" arising from misuse of alcoholic liquors. It exhibits itself first in fits of excitement of various kinds, and gradually leads to complete stupefaction. We should avoid irritating intoxicated persons, and endeavour to remove from them everything with which they could do injury to themselves or others. If stupefaction has already begun, the delirium is most easily removed by a long sleep; only if irregular breathing, or other circumstances cause us to suspect danger to life, the treatment recommended for other narcotic poisons should be employed.

§ **235. Fainting-fits and Cramps.**—By a fainting-fit is meant a sudden loss of consciousness which may arise from the effect of bad air, fright, loss of blood, and is often the result of an effusion of blood from the brain. After a preliminary feeling of giddiness and nausea, the person affected generally sinks down suddenly in an insensible condition. We should first loosen all clothing around the neck, chest, and abdomen of a person who has fainted, then we should lay him in an airy place, with his head low if his face is pale, with the head and upper part of the body raised if redness of the face indicates congestion of blood in the brain. In the first case the head should be sprinkled; in the latter, douches and water-bandages. If the faintness is the result of a fall or blow on the head, a position of complete rest, with the upper part of the body raised, should be provided for the injured person.

Good means for reviving persons who have fainted are:—rubbing the forehead with "eau de Cologne," and holding

strongly-smelling substances, such as smelling salts, or vinegar under the nose, using saturated cloths, or the moistened hands for that purpose. These liquids should never be held in a bottle under the nose, because by the movements of the person reviving, or by his sneezing, they may flow into the nose, and cause symptoms of choking. In severe fainting-fits, irritants applied to the skin such as rubbing, brushing, mustard-plasters over the region of the heart, are beneficial. After the patient has revived, he should be compelled to lie quietly for some time, and water or stimulants, *e.g.*, some teaspoonfuls of strong wine or coffee, or fifteen drops of spirits of wine in a tablespoonful of water, may be given to him.

Convulsive fits, especially epileptic convulsions, which may be known by loss of consciousness, contortions of the limbs, rolling of the eyeballs, clenching of the fists, &c., must not be confounded with fainting-fits. Persons attacked by convulsions should be laid on a mattress or quilt, hard or angular objects against which they might injure themselves removed from their vicinity, and the end of the attack awaited calmly. On the cessation of the convulsions there frequently follows a sleep of several hours, during which the patient is best placed in bed.

§ **236**. **Coma**.—By coma is meant a state of profound unconsciousness combined with lessening of respiratory motions, and extreme weakness of the heart's action; this state may easily pass into actual death. It is produced among other causes, by drowning, hanging, strangulation, inhalation of poisonous vapours (coal gas, fire-damp, carbonic acid in breweries), or of gases that cannot support life, freezing, heat-stroke, sun-stroke, lightning-stroke, and being buried under heaps of rubbish.

In order to revive a person from coma, it is first necessary to remove at once the cause of it. Persons who

are taken insensible out of water should, in the first place, have all water and mud in the mouth and breathing passages removed, by laying them on their side or belly, allowing the water, &c., to flow from their mouth, and then clearing it and throat with the finger. It is wrong to place such sufferers on their head so as to facilitate the efflux of the water. In the cases of persons who have hanged themselves, the rope, &c., confining the neck should be cut, but care should be taken to support the suspended body, so that it may not receive other injuries by falling. Fresh air should at once be provided for persons who have inhaled noxious vapours, by carrying the victims immediately into the open air.

§ 237. **Artificial Respiration — Treatment in relieving Person from danger of Suffocation—Foreign Bodies in the Natural Apertures of the Body.**—The second

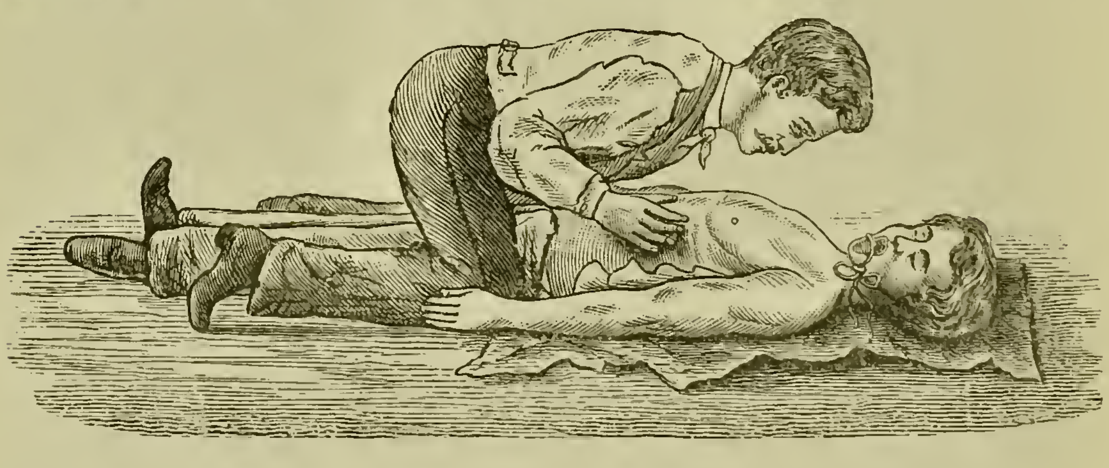


Fig. 50.
Artificial Respiration. 1. Expiration.

aid to be given without delay in cases of apparent death is the establishment of artificial respiration. The patient is stripped of all clothes covering the upper part of the body, and of all garments confining it, is laid on his back on the floor, a quilt or mattress, and the hips raised a little. The

tongue is drawn from the mouth, and is best held by one of the persons lending assistance (slipping is prevented by rolling it in a handkerchief), but in case of necessity it is

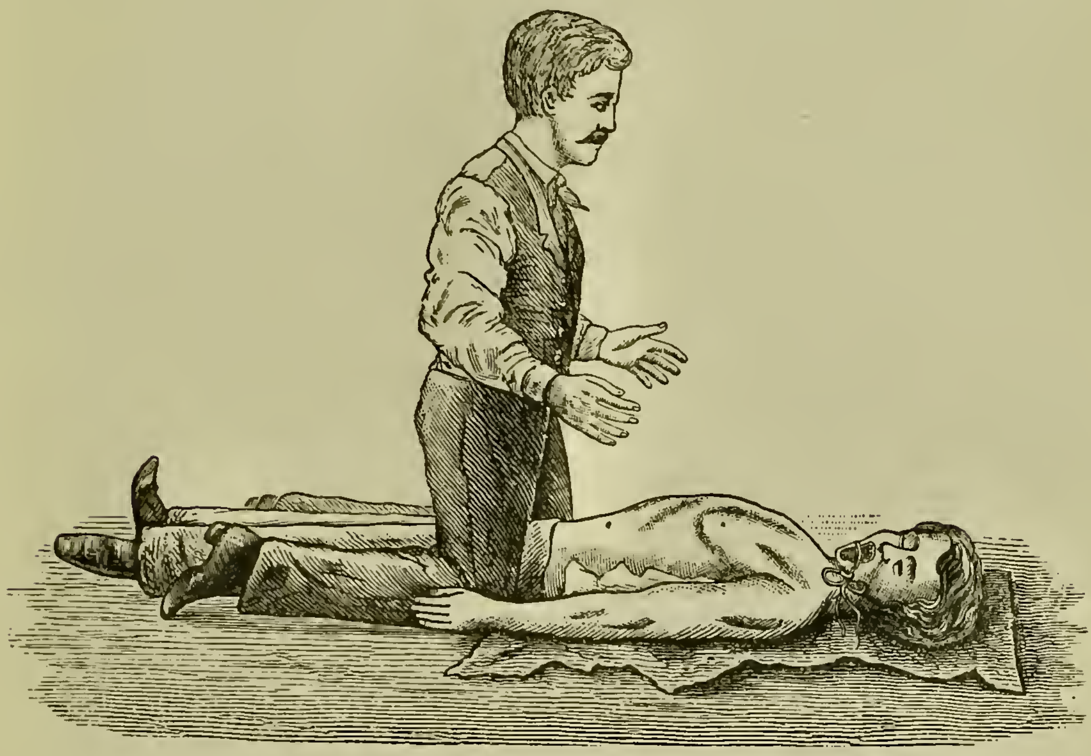


Fig. 51. Artificial Respiration. I. Inspiration.

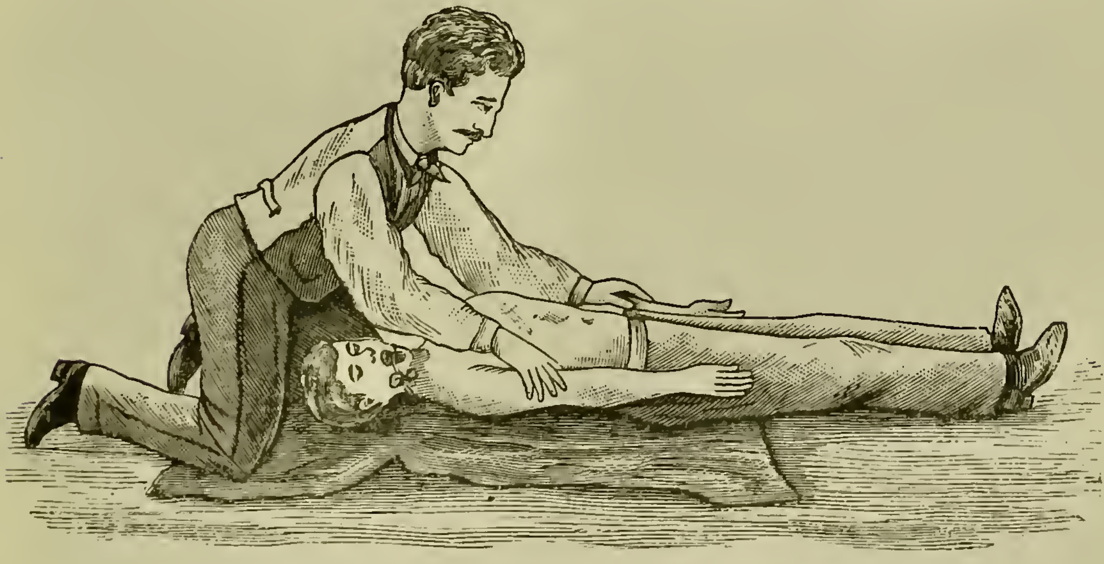


Fig. 52. Artificial Respiration. II. Expiration.

tied firmly by a string round the lower jaw so that it may not close the passage to the larynx by falling back. The operator then kneels down with his knees on either side of

the patient's hips, and with his hands placed below and to the side of the nipples, the fingers being laid together and not outstretched, presses slowly, and with his full strength, the ribs, against the back, and slightly in the direction of the head, so that air audibly escapes from the lungs. This pressure, in imitation of expiration, is maintained for two or three seconds, and may be increased by drawing the elbows close to the upper thigh and leaning the upper half of the body forward (Fig. 50). Then the operator suddenly raises himself up, the compressed chest of the patient expands on the relaxation of the pressure, and thus cause the lungs to expand at the same time, by entry of air as if by natural inspiration (Fig. 51). After two

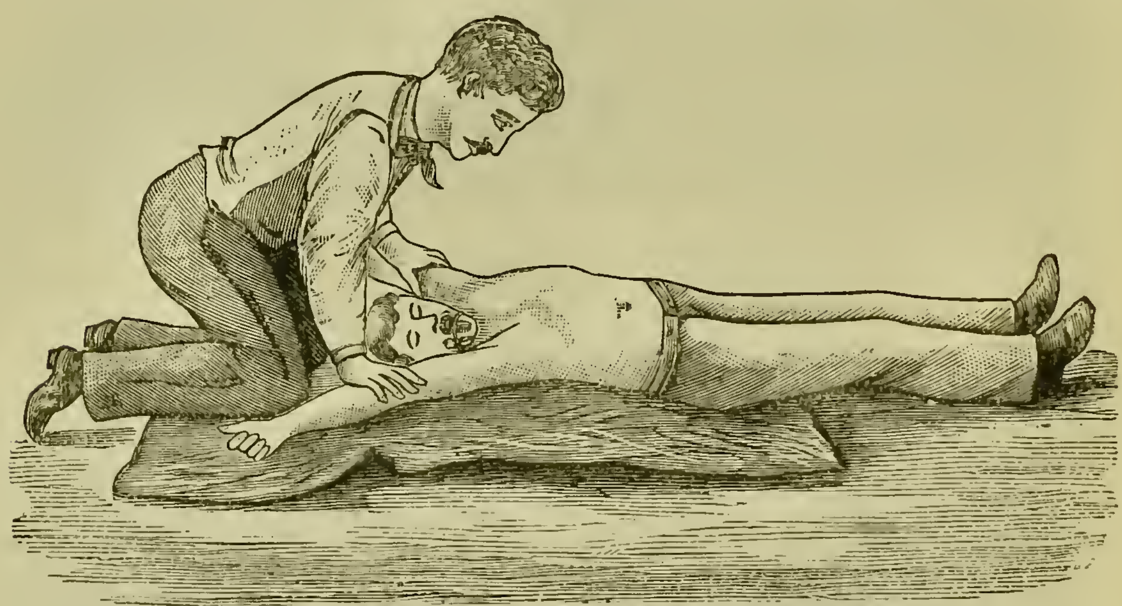


Fig. 53. Artificial Respiration. II. Inspiration.

or three seconds, the process begins anew, is repeated ten or twelve times per minute, and is continued until the respiratory movements are accomplished naturally without any help, or until skilled judgment pronounces resuscitation impossible on account of the person being actually dead.

It is an advantage if the operator is assisted in his work of rescue by a second person, who kneels at the head of the patient (Figs. 52 & 53), and increases the compression

of the chest during expiration by pressing the patients' arms closely against his sides, and the expansion of it during inspiration by raising his arms above his head. As soon as the sufferer is breathing again, efforts should be made to restore consciousness in the same way as in cases of fainting.

In giving aid to persons in danger of suffocation, those engaged in the work of rescue must observe certain precautions for their own safety. Before entering rooms filled with noxious gases, care should be taken to air them completely by opening the doors fully, and breaking in the windows from outside. If the latter is impossible, the rescuer holds a cloth moistened with water, or diluted vinegar before his mouth, hastens through the room, opens the windows, and goes to the sufferer only after the air has been cleared out, and a thorough draft set up. If suffocating persons are to be raised out of wells, shafts, pits, sewers, canals, deep cellars, &c., the rescuer is let down by a rope round his body, so that he may be drawn up at once; moreover, communication should be maintained with the bystanders by means of a line fastened to the arm, by pulling which a signal may be given in case danger requires the rescuer to be drawn up. If the noxious gas in such cases consists of carbonic acid, it may be made more or less harmless by pouring whitewash into the cavity. We should never enter rooms suspected of containing escaped gas, with a light; in such cases the main cock and all other gas-cocks that are open, should be at once closed.

In rescuing persons buried under falls of rubbish, &c., the rescuer should guard against similar injury to himself. The sufferer should be carefully raised, as he may have some bones broken. To facilitate his breathing, any earth that has got into the mouth is removed with the finger.

Danger of suffocation sometimes occurs as the result of

swallowing foreign substances such as bones, fish-bones, &c. An effort should first be made to withdraw such objects with the finger, but to avoid the risk of being bitten in doing so, a broad piece of wood should be placed between the teeth of the patient. If the foreign substance cannot be reached in this way, its exit may be promoted by pressure on the abdomen, strong blows on the back, or incitements to vomiting. If the substance is sticking, not in the wind-pipe but in the gullet, it may be successfully swallowed down along with a bread-crust or piece of fatty food, and so passed into the stomach. In serious cases that endanger life, the doctor may give assistance by using special instruments, and in extreme danger by an incision in the wind-pipe.

Medical aid must also be sought if foreign substances, insects, &c., find ingress into the eyes, ears, nose, or other natural apertures of the body, an accident frequently observed in the case of children. If such objects cannot at once be removed, incompetent persons should cease all further forcible efforts because serious injury may be caused by too violent pulling, tearing or piercing.

Supplement.

Elements of Nursing the Sick.

§ **238. Importance of Sick-nursing**.—By following the teachings of hygienic science we may reduce the number of cases of illness and injuries, but we cannot completely prevent them. There will always be sick and wounded, who crave the alleviation of their pains, and restoration to health, and require the care of their fellow-men. The healing of the sick and wounded is, in general, the duty of the physician, for the correct diagnosis of a malady, the decision on the suitable remedies, the nursing to be adopted, and the laying-down of the rules to be observed by the patient, must be based upon exact knowledge of the parts and functions of the body, as well as familiarity with the nature and mode of action of known remedies. The knowledge necessary for this purpose cannot be acquired without years of diligent study under professional guidance: the correct application of it is ensured by accumulating experience.

Besides the advice and aid of the doctor, however, careful nursing is of great importance in the course, and result of the disease, as well as for alleviating the troubles connected with it. It is not always possible to confide the patients to trained male and female nurses; anyone may be placed in the position of having to undertake the duty of nursing in person, should anyone under their care, fall ill. No one should delay making himself or herself familiar with the essential duties to be discharged in such cases. If limited means, and domestic relations make nursing difficult

in one's own household, it is advisable to remove the patient to an hospital. The more perfect arrangements of such institutions, which have constantly at hand trained nurses and doctors ready to give any assistance required, afford the best possible guarantee for recovery.

§ **239. The Sick-Room.**—The first requisite in nursing the sick is the arrangement of a suitable sick-room. The patient requires quiet above all things; hence, a room as isolated as possible, and one which is not at the same time occupied by healthy persons, should be provided, and, should the doctor consider it necessary, no one should enter it, except the persons entrusted with the treatment and nursing of the patient. Daylight should have abundant access to it, and there should be no lack of good artificial light during the evening and night; however, there should be some means of darkening the room, and of protecting the patient by screens, curtains, &c., from too glaring light, and from the heat of the sun. If an apartment is used as a sick-room in winter, it should possess good heating apparatus, capable of maintaining a constant temperature of 15°C. to 17°C.

Special attention should be paid to cleanliness in the sick-room. Objects likely to retain dust, and unnecessary furniture, which both make the room small, and increase the difficulty of cleaning it, should be removed. The floor should be swept every day, with as little discomfort to the patient as possible, and should be scrubbed now and then. The room should be aired every morning and evening, and each time the bowels of the patient are moved. The remains of food, utensils that have been used, excretions, dirty under-linen and bed-clothing, &c., should not be tolerated in the sick-room, but should be immediately removed, if necessary, after previous disinfection, or after scattering some disinfectant on them.

§ **240. The Sick Bed.**—The sick bed is best placed with the head resting against the wall, but so that it is freely accessible on the other three sides. It should be exposed neither to the direct heat from a fire, nor to a troublesome draught from the door or windows, and, if necessary, should be protected by large bed screens. It should be of a sufficient size, and be provided with good bedding ; mattresses well stuffed with horse-hair should be used. The bed-linen should be always clean, and hence must be frequently changed. In cases where the patients soil the bed-linen, the mattresses should be protected by a waterproof or India-rubber sheet. Well-stuffed pillows or cushions, which should not be too soft, are suitable supports for the head, or, where necessary, the upper part of the body. Woollen blankets are recommended as bed-coverings ; in many cases eider-down quilts may be used, on account of the habits of the patient ; but it is not advantageous to provide too heavy and too many bed-clothes.

Generally the patient finds most ease when lying on his back, with the head somewhat raised. In cases of difficulty in breathing, the upper half of the body should be raised by pillows, or by a stool under the mattress. The feet are placed resting against hard-stuffed cushions or a wooden block, in order to prevent the patients from slipping down in the bed. Patients too weak to sit upright find a cord attached to the foot of the bed useful, and if provided with a cross-handle, helps to raise them. The feeling of chill is counteracted by heated stones, or warm jars, *i.e.*, well-closed stone jars or metal vessels, filled with warm water. Such heating apparatus are laid in the bed, alongside the patient, but should be covered, so as not to touch the skin directly.

The bed should frequently be smoothed under the

patient, and also cleared of bread crumbs, sand, &c. It is advisable to make the bed at least twice a day. If the patient cannot leave his bed during the interval necessary for this purpose, he should be removed to another bed, or a sofa (*cf.* § 254). Before the patient is brought back to the newly-made bed, the latter should be heated, if necessary.

§ **241. Care of the Patient's Body—Bed Sores.**—Great attention should be devoted to the cleanliness, and nursing of the patient's body. In the case of weak patients, their face and hands, and if necessary, other parts of the body should be washed at least twice a day by the nurse with lukewarm water, a soft sponge being used. The hair should be combed at the same time. It is also necessary for the patients to continue daily to rinse their mouth and clean their teeth. In the case of patients unable to do this, the nurse should rub the mouth from time to time with a damp cloth. It is often refreshing to feverish persons to have their dry lips rubbed with mild oil or ointment.

A frequent change of linen is advantageous for all sick persons, especially those who perspire. The change of linen should be effected only when perspiration has ceased, and the patient's skin has been dried under the bed-clothes with warm cloths. A change of shirt is best carried out by opening all buttons, strings, &c., under the bed-clothes, slipping the shirt from under the patient by gently raising him, and then quickly, but carefully, pulling it over his head and arms. The fresh shirt, which should be previously warmed, is then slipped in the same way over the head and arms, and then drawn down as smooth as possible, under the bed-clothes.

By attention to cleanliness, and proper management not only is the comfort of the patient promoted but the precaution against the dreaded bed-sores are fulfilled. With patients confined to bed for a long time, the parts of the

body on which they principally lie, the heels, loins, buttocks, and region of the shoulder blades easily become sore. First appear redness and sensitiveness of the skin ; then sore spots are observed, which quickly increase in size and become deeper, cause the patient much uneasiness, and may become dangerous by producing blood-poisoning. Such undesirable results are inevitable in the course of some diseases, if the body, as well as the under and bed-linen of the patient is not kept scrupulously clean, and if diligent attention is not paid to keeping the ticking smooth and free from wrinkles. As soon as a bedsore has developed, its healing occasions great difficulties, as the patient is compelled to lie further on the same spot. Hence the sick nurse should take special care to notice red or painful spots upon the recumbent portions of the body, and to call in medical advice the moment they appear. It is frequently advantageous to moisten the skin when red and inflamed, with lemon juice, camphorated wine, or French brandy, but is especially advisable in prolonged cases of illness to lay air-beds or water-beds on the mattress, as bedsores are not so easily developed on such supports.

§ **242. Sick Watching—Conduct of the Nurse.**—A nurse should be constantly present with patients seriously ill, in order to observe them, and to hand them anything they require. Especially excited and delirious patients require incessant watching, so as to be restrained from actions that may cause injury to themselves and others. In such cases the nurse should restrain the patient in calm and moderate fashion from senseless actions, and also should strictly follow the directions of the doctor, and report to him at his next visit, all her observations in regard to the conduct of the patient. If night watching beside the patient, is ordered by the doctor, care should be taken to provide a change of nurses, so that the nurse entrusted with watching may have time to rest before resuming duty.

The nurses should discharge their duties quietly and noiselessly, should not worry the patient with their own uncertainty, anxiety, or troubles, and should be as gentle as possible in giving any assistance. In the care of persons suffering from contagious diseases, they should avoid eating, drinking, or putting their hands to their mouth while in the sickroom. After touching the patient, the hands should be washed with soap and a brush; when leaving the sickroom the clothing should be changed if there is any danger of infection. It is advisable while remaining with the patient to place an apron or other similar garment of washing materials, over the entire clothing.

§ **243. Sleep and Breathing of the Patient.**—As a rule the nurse should not disturb the patient's sleep. In cases where too long a sleep is injurious, or where the patient must be awakened, *e.g.*, to take medicine or at meal time, the doctor should first give corresponding directions. A well ventilated room, a freshly-made bed, soft light, and for feverish patients, the administration of cooling drinks, facilitate the patient's falling asleep. The nurse should pay attention to the patient's breathing so as to be able to report afterwards whether it was rapid, or difficult and painful, accompanied by groans, and movement of the nostril. In case a rattling in the chest causes the nurse to suspect an accumulation of phlegm in the air passages, the patient should be put sitting up from time to time, to facilitate his coughing it up. The patient should be cautioned not to swallow his expectoration, but to spit it into spitting glasses which the nurse holds before him with one hand while the other catches the pillows under his head, and supports the upper half of the body in a sitting position. The expectoration should be kept until the doctor's next visit, in order to be shown to him, and rendered innocuous or removed according to his directions.

§ **244. Bleeding.**—Special attention and help are necessary in the case of much bleeding from the mouth. This comes generally from the lungs if it follows coughing, and is expectorated of a bright-red colour, mixed with air-bubbles. Vomited blood, on the other hand, is usually of a dark-red colour, and arises from a blood-vessel in the stomach, having been opened by ulcerating processes. In every case of violent bleeding it is necessary to summon the doctor immediately, but until his arrival the patient should be kept as quietly as possible on his back, with the upper part of the body raised, all talking should be forbidden to him, and according to the supposed locality of the bleeding, the chest or stomach should be kept cool by ice-cold bandages or an ice-bladder. On the recurrence of internal bleeding (which is recognizable by the resultant sudden corpselike pallor of the patient), the same provision should be made for quiet position of the patient, and immediate summoning of the doctor.

§ **245. Heart-beat, Pulse, Temperature of the Body.**—It is frequently useful to observe the heart-beat of the patient, to count his pulse from time to time, and to take the temperature of his body so as to be able to report to the doctor regularly, the results of such observations from notes made at the time. The temperature of the body is measured by the invalid (clinical) thermometer, divided into degrees and tenths. This is placed with the mercury bulb in the carefully dried hollow under the arm of the invalid, the latter is requested to keep his arm close to his body (for which the assistance of the nurse is necessary in cases of weakness or delirium) and at the end of ten minutes the height of the mercury is read. After two minutes longer, note is taken whether the mercury has risen higher; where this is not the case the temperature indicated is written down; otherwise the reading must be taken at

intervals, until no further rise is indicated within a space of two minutes. Before each reading it should be noted whether the thermometer already stands above 36° Centigrade, by swinging it up and down the sinking of the mercurial column may be effected.

§ **246. Natural Excretions of the Patient—Injections and Enemas.**—At the order of the doctor or as soon as the urine and excreta of the patient exhibit unusual characters, these excretions must be preserved (outside the sick room); if they do not take place at the regular time this fact should be reported to the doctor. For patients who cannot, or dare not leave the bed, pans and urinals should be used (warmed). During evacuation the patients are to be supported by the nurse. If the linen is soiled by chance, it should be immediately replaced by clean linen. In order to avoid, as far as possible, such occurrences with patients who pass their excreta involuntarily, the vessels intended for their reception should be placed under them, unasked from time to time. Patients who get up for these purposes are to be protected against chill by clothing or suitable wrapping.

To stimulate the action of the bowels, injections by means of syringes sold for that purpose, or, better, enemas by means of the so-called irrigator (Fig. 54) are administered, the fluid being thus, either forced in, or allowed to flow into the rectum. In purchasing instruments for this purpose, care should be taken that the nozzle of the syringe or irrigator is rounded and made of flexible material, so that no injury may be caused to the rectum by its insertion. These instruments should never be used without being first thoroughly cleaned. The operation itself is generally performed in the following manner:—The patient is laid on his side (a vessel being placed alongside him on the bed, previously protected against wetting by a water-

proof sheet), and is supported in this position by placing a hand on the back, with the other hand the nozzle of the syringe or irrigator is carefully inserted in the orifice, and then by gentle uniform pressure on the piston of the syringe, or by moderate raising of the irrigator, the liquid is allowed to run in. Unless the doctor orders otherwise, the liquid used for such injections may be composed of one quart of water, with one or two teaspoonfuls of salt added. The effect of the injection or enema is all the more certain the longer the liquid is retained by the patient.

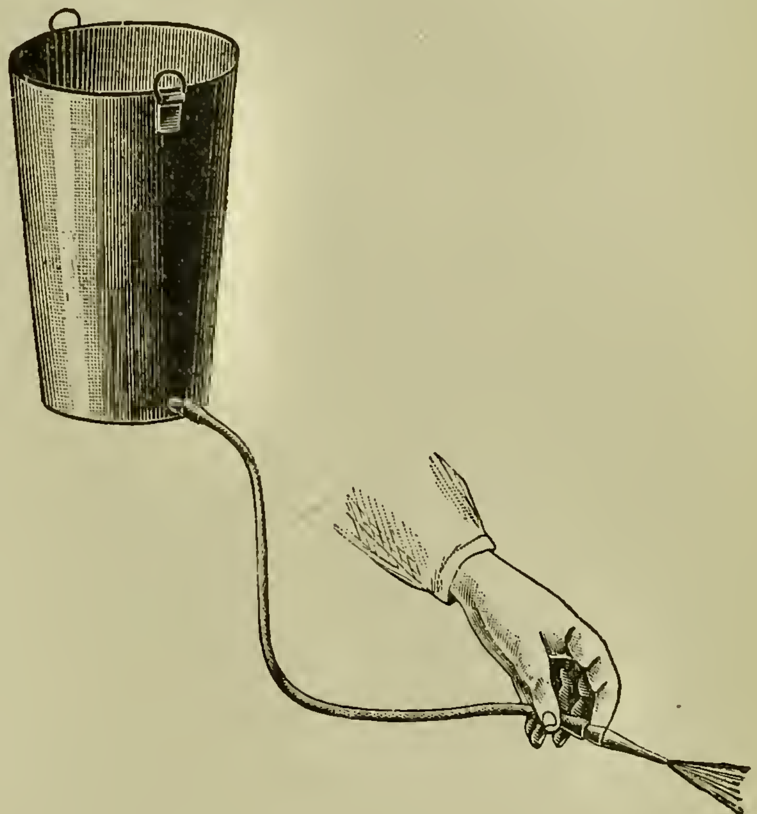


Fig. 54. Irrigator.

§ 247. **Vomiting, Attention to Bandages, Nourishment of the Invalid.**—When vomiting, the patient is to be assisted by raising and supporting his head (§ 243). He should be induced to suppress the inclination to vomit as long as possible, because the process of vomiting is thereby shortened, and the unpleasant retching is in some degree lessened. When the vomiting is over, the nose and mouth should be cleaned. It is also well to refresh the patient with small quantities of cooling drinks. The vomit itself must be kept until the arrival of the doctor.

The nurse must have an especially watchful eye on the

temporary bandages of the patient. Any disturbances that appear are to be skilfully set to rights. If a sudden redness or saturation of the bandage with blood announces an increased bleeding, the physician should at once be informed. Until his arrival the directions indicated in § 231 are to be followed.

The class of his nourishment is very important to the well-being of the patient. The neglect of the doctor's directions may occasionally exercise a highly prejudicial influence on the course of the disease. (Compare § 202.)

In public hospitals strict measures are taken that visitors from without do not bring improper foods and dainties to the patients. As a rule, in the beginning of an illness, before the doctor is called in, it is well to give only slop food, such as milk, thin barley or oaten gruel, with the addition of some meat soup, but not to force the patient to use food of this kind. As a refreshing beverage, water boiled with some lemon-juice and sugar, and allowed to cool, may be recommended.

§ **248. Giving of Medicine.**—All remedies must be administered at definite times, and in measured quantities as prescribed. Liquid medicines are kept cool by placing the bottles in a vessel partly filled with water. At each dose, the medicine (after shaking the bottle), should be poured into a spoon or wine-glass, previously well cleaned, and brought to the patient's mouth, who is at the same time supported in a sitting position. Pills or capsules are most easily swallowed down with a mouthful of water. Powders are best mixed in a spoon with some water, unless it is preferred to administer them in wafers. For the latter purpose a wafer about 2½ inches in diameter is moistened on a plate, and the powder shaken on it; it is then rolled into the form of a ball, and swallowed by the patient with some water.

The use of violence in giving medicines to refractory patients is permissible only in rare cases to be determined by the doctor, *e.g.*, with children.

Unfortunately, an exchange of medicines has frequently led to accidents, hence we should satisfy ourselves each time before giving them, by reading the inscription on the label attached to the medicine bottle, so as to exclude the possibility of mistakes. The free use of medicines should never be permitted to unreliable patients.

§ 249. Painting, Embrocations, Massage.—Painting, embrocations, and massage are to be carried out strictly according to the doctor's directions. Massage, like a number of other operations necessary in nursing the sick (*e.g.*, leeching, cupping, &c.), requires some practice, and hence is usually left to trained persons. Scientifically executed, it may be very beneficial in many cases, *e.g.*, in removing swellings in the joints, or in restoring flexibility in the limbs after the union of bone-fractures. As its application in unsuitable cases may also have injurious results, this treatment should only be applied in pursuance of the doctor's orders.

Any one may be safely entrusted with the application of embrocations. The liquids or ointments ordered for this purpose are rubbed on the surface of the body either with the finger-tips, or the ball of the thumb, or the whole palm of the hand with a circular motion and a pressure sometimes gentle, sometimes strong, but always uniform.

§ 250. Mustard Plasters and Blisters.—Sometimes mustard plasters, or blisters are ordered for the patient. Instead of the former, the mustard-paper readily bought, is used in recent years. This is moistened on the coated side, and laid for ten or fifteen minutes on the portion of the skin marked by the doctor; after its removal, the skin (which will be very red if the plaster has acted), must

be washed with a soft sponge and warm water. Spanish fly-paper is used for blisters: it is similarly moistened and kept on for from twelve to twenty-four hours, in each case until a blister has formed on the skin. After its removal, the blister is punctured with a needle (that has been heated red hot and cooled), and is dressed with ointment, as soon as the liquid has flowed out. Any dirt is to be carefully avoided as the part of the skin under the blister is to be regarded as a wound.

In applying blisters and mustard plasters those portions of the skin on which the patient lies, joints, and particularly sensitive parts of the body, as the nipples and navel, must not be selected. Great care must be taken with Spanish fly-blisters as the constituent to which their effect is due, is poisonous.

§ **251. Ice-bags—Cold Bandages.**—As ice-bags, bladders made of impenetrable materials (such as india-rubber and capable of being well closed), are used. These are filled with ice, broken to pieces the size of a hazelnut or walnut by wrapping a large piece in a cloth, and smashing it with a hammer. The ice-bag is laid as wide as possible on the spot indicated by the doctor. It should be wrapped in a linen cloth, because the water-tight material easily deteriorates, and then its dampness is very uncomfortable to the patient. In many cases, as when laying it on the head, the ice-bag is fastened by a string to the bedpost so that it can neither slip off, or press too heavily.

Where an ice-bag cannot be procured, an effort is made to replace it by cold bandages. A handkerchief or napkin folded several times, is laid on a piece of ice or in the coldest possible water, wrung out well after some time, and applied to the part of the body to be cooled. As a bandage of this kind quickly heats on the skin, it must be frequently changed—in some cases, every minute.

§ 252. Cold Douches and Swathings—Moist and Warm Bandages—Dry Heating.—While ice-bags and cold bandages have in view a longer or shorter cooling, the effect of cold douches and swathings partly rests on the fact that the blood driven out of the skin by the cold afterwards flows back again in increased quantity. In this way circulation, as well as the excretary functions of the skin and kidneys is stimulated, and a pleasant heat produced in the body. This method is employed by healthy persons in order to "harden" themselves; it should never be used without medical advice, as such "cures" are injurious to many people.

Moist warm, or hydropathic bandages effect a permanent increase of the blood contained in the skin. They consist in wrapping or covering the skin with wet muslin (not dripping water) or moist linen, which is prevented from drying up by an envelope of waterproof material, and is fastened by strings or cloths. Whether cold or warm water is used for damping the bandage is immaterial, as the heat of the body soon communicates itself to it.

In many cases use is also made of dry heat in the treatment of patients by fastening to the surface of the body heated cloths or sacks filled with sand, bran, chaff or herbs. Such appliances are popular among other things, for alleviating toothache; still for this purpose frequent rinsing of the mouth with camomile tea, as hot as possible, is often more effective.

§ 253. Baths—Sweating—Cures.—Baths are extensively used in sick nursing. Distinction is drawn between full baths, and local baths, such as half baths, hip bath, arm bath, hand bath, and foot bath. The bath water is sometimes hot (96° to 104° F.), or warm (87° to 95°), or lukewarm (78° to 86°), or cool (69° to 77°), or cold (60° to 68°). Ordinary water or water from curative springs is selected as the doctor orders; the addition of salt and other

substances is often beneficial. The opinion of the doctor should first be obtained as to the kind and duration of each bath, as well as the shampoos, douches, &c., to be combined with it. Sometimes hot air (Roman) baths, or steam (Russian) baths are ordered, but they should be taken only in special bathing establishments. If baths are to be taken by patients seriously ill, it is advisable to have strong wine at hand, as weaknesses sometimes occur in the bath. Immediately after the bath the patient should be quickly dried and dressed, or put back in bed. Bathing vessels used by infectious patients should be disinfected. In case it is intended that the patient should perspire after the bath, he is completely wrapped and well covered in with a woollen sheet. When the perspiration is over he should be treated in the manner indicated in § 241.

Sometimes it is sought to stimulate the flow of perspiration by hot drinks. The kinds of tea used for this purpose (elder tea, linden blossom tea) are prepared by putting a certain quantity of the substance into a well-warmed vessel filled with boiling water, and then straining it through a sieve or clean linen cloth.

§ **254. Transport of the Sick.**—If it is necessary to transport the patient to other apartments he must be protected by suitable wrappings against taking a chill. In lifting and carrying him, two persons must lend their aid, one of them supporting the legs while the other grasps the patient by the loins and shoulder, the patient in turn clasping the latter round the neck. In removing the sick from house to house, either stretchers, or well cushioned carriages should be used. In case of necessity, a door taken off its hinges, a large sack supported by a pole on either side, a ladder covered with a mattress, &c., may be used as stretchers. When it is advisable, carriages should be carefully driven at a walking pace.

Appendix.

Some German Laws of Health.

(a) Sale of Food, &c.

By a law passed in 1879 police officers are empowered to enter shops where articles of food are offered for sale, and to take samples of them. The imitation or adulteration of food and stimulants with a view to trade deception, the sale of putrid, falsified, or adulterated food and stimulants, and the offering them for sale under a description calculated to deceive purchasers, is forbidden. The manufacture, sale, or trafficking in food, stimulants, and other necessaries, whose consumption or use is injurious to or may destroy health, is forbidden by heavy penalties (in some cases by imprisonment).

The application of these general principles is further facilitated by special enactments with reference to particular necessaries of life. Thus :—

1. Petroleum, which gives off inflammable vapour at a lower temperature than 60° F., must be kept in vessels bearing the inscription "inflammable" in large indelible characters, in a prominent position.

2. Eating, drinking, and cooking utensils cannot be manufactured of lead, or of any alloy containing more than ten per cent. of lead ; they cannot be coated internally with any metallic alloy containing more than one per cent. of lead. The latter regulation applies to all objects which come in direct contact with the mouth, or which are used for preserving meat, fruit, spirits, &c. These precautions are for the purpose of preventing cases of lead poisoning.

3. No colouring agents can be used in the manufacture of food or stimulants which contain any of the following substances :—Antimony, arsenic, barium, lead, cadmium,

chromium, copper, mercury, uranium, zinc, tin, gamboge, coralline, picric acid. Such colours cannot be used in the wrappings of provisions, in making soap, or other preparations for the skin and hair, in manufacturing toys, &c. In particular, the use of arsenical colouring stuffs is strictly forbidden in the manufacture of carpets, curtains, wall-paper, paints, furniture, artificial flowers, clothes, type, &c., &c.

4. The sale of imitations of butter is forbidden, unless they are distinctly labelled and sold as oleo-margarine, margarine, &c.

(b) Factory Legislation.

Children under 13 years of age cannot be employed in factories or workshops, and over that age they can be employed only when they have completed their school course. Children and young women cannot be employed in factories declared to be dangerous to health and morality. This last enactment has been at various times extended to include wire-drawing mills, glass-works, sugar refineries, rolling and hammer mills, brick-works, coal, tin, and lead mines, &c.; each of these trades are also subject to special restrictions.

Again, children under 14 years cannot be employed longer than six hours per day; young people between 14 and 16 years, not longer than ten hours daily. Work shall not begin for them earlier than half-past five in the morning, nor be continued later than half-past eight in the evening, and it must be broken by regular intervals. The same regulations apply to females, and even if they are more than 16 years of age they cannot be employed longer than eleven hours daily, or ten hours on Saturdays and the days before holidays. Moreover, they must be allowed a mid-day rest of one hour, which is to be increased to an hour-and-a-half if they have to look after the house-work at home.

Workpeople are not bound to work on Sundays and holidays. Nearly all heavy labour must cease on these days, exception being made in favour of factories which cannot cease working, or which can work only at certain seasons of the year, or which are subject to unusual pressure of

work at certain seasons. Otherwise all workers are entitled to twenty-four hours' complete rest on Sundays and holidays; thirty-six hours rest if two such days are consecutive, and forty-eight hours' rest at Christmas, Easter, and Whitsuntide. In the cases excepted, an equivalent must be given on ordinary working days to those employed during these periods of rest.

(c) Compulsory Insurance against Sickness, Death, Accidents, and Old Age.

In Germany, at present, all persons, male and female, engaged for wages or salary in trade or business (about eight millions in number), are compulsorily insured, the employer paying one-third, and the employee two-thirds of the premium. This law does not include domestic servants or agricultural labourers. Each person insured, receives in case of sickness medical attendance, medicine, and other necessaries for his recovery (*e.g.*, spectacles, trusses, &c.), free; if he is incapacitated from work, he receives at least half the usual or average day's wage for each working-day that he is invalided. These advantages are continued for thirteen weeks, if the illness lasts so long. Also a sum is paid to the relatives in case of death for the purposes of burial, &c. The insurance against sickness is carried out by the sick clubs, each trade or occupation possessing one.

The insurance against accident is far more widespread than the insurance against sickness. All persons (about 18 millions) engaged in industry, and agriculture are subject to it, as well as subordinate trade officials, and small contractors (the latter includes four millions of small landowners). The extension of accident insurance, to callings not yet included in it, is imminent. All persons included, are by law insured against the results of accidents occurring in the course of their business, even if the victim himself, or a third party is the responsible cause of the accident. All sudden occurrences connected with the industry are to be deemed accidents, not including, however, results gradually produced by long continued employment, *e.g.*, in mercurial works, lead works, tinder factories, &c. Accident insurance guarantees com-

pensation to the wounded. This compensation consists in defraying all the costs of recovery, as well as a money payment for the period during which the sufferer is incapable of work, not exceeding two-thirds of the previous year's average earnings. These payments do not begin until the fourteenth week after the accident, up to which time the patient is entitled to support in virtue of the insurance against sickness. If death results from the accident, the relatives receive money to defray burial expenses, and the widow and children receive annuities, the former until death or re-marriage, the latter until they attain fifteen years of age. The cost of accident insurance is borne exclusively by the employers, who are associated for that purpose.

Incapacity for work resulting from age (70 years), and not from temporary illness or accidents covered by the accident insurance, is provided for by the law, as insurance against inability to work, and old age. This law applies to all labourers in all branches of trade (exclusive of apprentices and servants), and to officials and messengers earning less than £100 per year—in all embracing about twelve millions of persons. The benefit of this law, namely, an annuity varying according to wages and number of years the person has been subscribing (on an average the annuity is £7 10s.), accrues especially to those incapacitated from labour by accidents outside their trade, or by diseases gradually contracted in their employment (see above). The necessary funds are partly supplied by the State, which adds £2 10s. annually to the amount subscribed in equal shares by the employer and workman.

(d) Vaccination.

Every child in the calendar year in which the completion of its first year's existence falls, and every pupil of a school in the year in which he completes his twelfth year, must be vaccinated unless a previous fit of smallpox ensures immunity from a recurrence of the disease. Those liable to military service are revaccinated on entering the army, or navy. By the appointment of vaccinating doctors, paid by the public Treasury, everyone is afforded an opportunity of obeying the law as to vaccination without any expense.

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